AD-A271 083

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

...n is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, ...ting and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this ...cing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson ...nd to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1993	Interim Draft

4. TITLE AND SUBTITLE
Coordinated Navy Hazardous Material Substitution Manual (Interim Draft)

5. FUNDING NUMBERS
C: F33615-89-D-4003
Order Nr. 0016

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8. PERFORMING ORGANIZATION REPORT NUMBER
Technical Report
AFMA-93001

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Department of the Navy
Naval Supply Systems Command
Code 452
Washington, DC 20376-5000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
N/A

11. SUPPLEMENTARY NOTES
Proposed under subcontract with Engineering-Science, Inc., for the US Navy, through USAF/PKR, Brooks AFB, TX

12a. DISTRIBUTION/AVAILABILITY STATEMENT
UL

12b. DISTRIBUTION CODE
UL

13. ABSTRACT *(Maximum 200 words)*
Provides guidance for accomplishment of a comprehensive Hazardous Material Substitution Program. Does not replace Navy directives but includes a step-by-step procedure and algorithm for screening, rating and comparing two or more hazardous materials. It also identifies "high" or "serious risks" requiring special approval for use and contains a detailed logic scheme to include the algorithm, economic analysis, and engineering suitability evaluation in the decision process.

93-24134

14. SUBJECT TERMS
Hazardous Material, Hazardous Material Selection

15. NUMBER OF PAGES
85

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

AFMA Tech Report 93001
August 1993

COORDINATED NAVY HAZARDOUS MATERIAL SUBSTITUTION MANUAL

Prepared for:
U.S. Navy
Naval Supply Systems Command
Code 452
Washington, DC 20376-5000

Armstrong Laboratory
AL/OEBE
Brooks AFB, TX 78235-5000

FOREWARD

The Department of Defense and the US Navy have existing policies and regulations to ensure that the use of hazardous materials is controlled in manner which protects human health and the environment at the least cost. Hazardous Material Control and Management (HMC&M), implemented under OPNAVINST 4110.2, is a Navy-wide program that requires controlling and managing hazardous materials on a life-cycle basis in order to minimize the generation of hazardous waste. HMC&M actions are required from initial system concept formulation on through the research, development, acquisition, production, operation, and final disposition phases.

The overall objective is to increase user's perceptions of how to ensure operation readiness while reducing hazards to life, property, and the environment through the application of a rational, systematic methodology to select the least hazardous materials consistent with life cycle cost and operational considerations.

AFMA Tech Report 93001
August 1993

COORDINATED NAVY HAZARDOUS MATERIAL SUBSTITUTION MANUAL

Enclosure (1)

TABLE OF CONTENTS

COORDINATED NAVY HAZARDOUS MATERIAL SUBSTITUTION MANUAL

APPENDICES

CHAPTER 1

GENERAL POLICIES, RESPONSIBILITIES AND ACTIONS

1-1 SCOPE

This Manual provides overall policy and guidance for the accomplishment of a coordinated Navy Hazardous Material Substitution Program. It serves as the basis for specific implementing plans and procedures to meet the needs of the Navy to achieve a consistent, uniform approach to reduction in the use of HM consistent with mission needs, engineering suitability, and life cycle cost considerations.

1-1.1 Coordination.

a. This Manual does not replace directives in other Navy or DoD publications. It is based on, and is consistent with, the requirements in references (a) through (d). Existing "lead" action assignments are not changed except for Ozone Depleting Substances as detailed below. The procedures in this Manual are to be used in the other programs as applicable.

b. The Clean Air Act (CAA) as amended in 1990 requires EPA to phase out production of ozone depleting substances (ODSs) and restrict the use of ODS substitutes that may pose a risk to human health and the environment. EPA must publish a list of approved and prohibited substitutes based on their review and study of their related health and environmental effects.

c. This review and study is being conducted under the Significant New Alternative Program (SNAP) which is designed to firstly identify potential substitutes for ODSs, secondly evaluate their human health and environmental risks, and thirdly encourage the use of those substitutes believed to present low risk.

1-2 GENERIC PROCEDURES FOR ALL SUBSTITUTION ACTIONS

1-2.1 Consistency with Regulatory and DoD Requirements. Navy HM substitution programs and projects are to be consistent with the requirements of Federal, state, and local codes, standards, and regulations and with DoD and Navy requirements. Appendix A is a summary of the more relevant codes, standards, regulations and DoD and Navy requirements.

1-2.2 Approval of High and Serious Risks. When a substituted material presents a high or serious risk, the requirements of

Part 6, Section I, reference (b) for approval by higher authority are to be complied with. In brief, "high risks" must be approved at the DoD Component Acquisition Executive (or designee at the Deputy Assistant Secretary or Three star level); "serious risks" must be approved by the Program Executive Officer or equivalent level.

1-2.3 Coordination on Substitution. Substitution procedures must ensure that adequate coordination and communications are established and maintained among Echelon 2 Commands and SYSCOMs on substitution actions.

1-2.4 Resources. Resource requirements for accomplishment of substitution programs must be identified and included in the Program Objective Memorandum (POM) and other funding requests.

1-2.5 Substitution Methodology. The substitution algorithm methodology (see Chapter 4 of this manual) is to be utilized as a screening and rating system for comparing two or more HM and for identifying high and/or serious risks. This is to ensure a consistent, uniform approach in the initial selection of substitutes.

1-2.6 Implementing Instructions. Major Claimants may issue implementing instructions, which include these basic procedures, tailored to provide command specific needs.

1-3 RESPONSIBILITIES AND ACTIONS

1-3.1 DCNO (Logistics), N4

a. Provides overall program management (N45).

b. Establishes HM substitution policies.

c. Coordinates substitution effort with Office of Assistant Secretary of the Navy (Research, Development, and Acquisition) and Assistant Secretary of the Navy (Installations and Environment).

1-3.2 COMNAVSUPSYSCOM

a. Serves as N45's Executive Agent for management and administration of the substitution program (SUP 452).

(1) Coordinates and manages the supply aspects of the program.

(2) Develops, maintains, reviews, and publishes an HM Substitution Project Management Plan (PMP) with Echelon 2 Commands.

(3) Develops and implements a tracking procedure for review and revision of specifications, NSNs, and related documents using the "Standardization Accomplishment Report" - RCS DD-DR-E(A)758 (reference DoD 4120.3M, Defense Standardization Manual). An annual report as of 31 December is to be submitted to N45 by 1 March.

(4) Coordinates with other major claimants to provide for orderly transition from existing HM to the new, less hazardous items. Establishes policies and procedures to ensure inventory managers are notified of current and planned HM substitution reviews so that appropriate adjustments are made to pending procurements.

(5) Establishes policies and procedures for drawdown of existing stocks, turn in of substituted items for disposition, and issuance of new NSNs for approved substitutes.

(6) Coordinates Navy approved substitution actions with other military departments, GSA, and DLA.

1-3.3 <u>Commanders of Systems Commands</u>

a. Establishes and maintains a Command HM Substitution Program Plan, as required by OPNAVINST 4110.2, paragraph 9, for those HM specifications, technical publications, and other documentation under their cognizance. Such plans are to include:

(1) Assignment of responsibility for overview, management, and coordination of HM substitution actions, including designation of a Command Hazardous Material Manager.

(2) Review and revision of specifications, maintenance and other relevant documents.

(3) Provision for coordination with NAVSUP and Echelon 2 Commands on Substitution and other Hazardous Material Management issues.

(4) Instructions to all personnel on how to submit suggestions and requirements for substitution actions.

b. Annually (as of 31 December) provides NAVSUP with copy of the Command's "Standardization Accomplishment Report." The

reports are to include the number of specifications planned for review during the period and the number of specifications actually reviewed. Of the specifications actually reviewed, the report should include both the number of HM substitution actions that were approved for use (with supporting data including: the number of specifications in which HM was eliminated; reduced in percent composition; and/or changed to improve overall safety) and the number of specifications eliminated from use.

c. In coordination with NAVSUP, develops and implements plans with the cognizant inventory manager for orderly transition from existing HM to approved less hazardous items.

1-3.4 Fleet Commanders In Chief (CINCs)

a. In accordance with paragraphs 8.(b) and 9 of OPNAVINST 4110.2, establishes and implements plans, schedules, and actions to review HM specifications, Maintenance Requirements Cards (MRCs), and other maintenance instructions and manuals to identify HM and provide recommended substitute actions to cognizant SYSCOM and NAVSUP.

b. Issues implementing instructions consistent with this Manual for HM substitution procedures for locally authorized materials at activities under their command.

1-3.5 Bureau of Medicine and Surgery

a. Through NAVENVHLTHCTR, provides consultation analysis and expertise to Echelon 2 Commands on environmental and health criteria and risk assessments for proposed HM substitution actions.

b. Through NAVENVHLTHCTR, provides consultation and assistance on HM Life Cycle Cost Analysis for proposed HM substitution actions.

1-3.6 NAVSAFCTR

Provides safety criteria and consultation on safety risks for proposed HM substitution actions.

1-3.7 ACAT I and ACAT II Program Managers

Develop and implement field level HMC&M elimination/ substitution programs for all acquisition category I and II weapon system acquisitions under their cognizance. These

CHAPTER 2

REGULATORY COMPLIANCE REQUIREMENTS

2-1 ENVIRONMENTAL/HAZARDOUS MATERIAL REGULATORY COMPLIANCE

The hazardous material substitution process may be initiated for several reasons ranging from health and safety needs to the desire to reduce hazardous waste disposal costs. Foremost among these reasons is the U.S. Navy's requirement to comply with the substantive and procedural requirements of statutes, laws, rules, and regulations of the Federal, state, and local governments.

2-1.1 <u>Need for Compliance</u>. The need for environmental/hazardous material regulatory compliance is twofold. First, the Department of the Navy is committed to a strong environmental ethic including operating its ships and shore facilities in a manner compatible with environmental goals. Second, there are many environmental and pollution prevention statutes, laws, rules, and regulations promulgated by Federal, state, and local governments that directly affect the capability of the U.S. Navy to carry out its mission.

2-1.2 <u>Waiver of Sovereign Immunity</u>. The major environmental statutes contain waivers of sovereign immunity that require Federal agencies to comply with Federal, state, and local substantive and procedural requirements. Most of the statutes incorporate provisions for personal liability of Navy personnel for failure to comply with the law. These liabilities may be for damages to people and property due to actions or inactions, for civil fines to enforce compliance with statutes, and for criminal penalties to punish violation of the laws.

2-1.3 <u>Need for POA&M</u>. For the above reasons, Navy organizations and personnel must have a thorough understanding not only of the impacts of current environmental laws on the Navy mission but also, and perhaps more important, the impacts of proposed statutes, laws, rules, and regulations on future Navy operations. Navy organizations must be involved with the environmental and hazardous material rulemaking process and must develop plans such as a "Plan of Action and Milestones" (POA&M) to identify and offset potential adverse impacts in a timely manner. Substitution of hazardous material (material and/or process changes) is one possible major means of minimizing regulatory impacts. Knowing the time phase for compliance and initiating appropriate substitution action can often reduce costly monitoring, permits, and other compliance impacts.

2-2 FEDERAL AND STATE GOVERNMENT RULEMAKING PROCEDURES

2-2.1 Federal Rulemaking.

a. Rulemaking in the Federal sector follows the procedure outlined in the Administrative Procedure Act. The Act requires publishing a general notice of the proposed rule in the Federal Register. The notice may be termed "Advanced Notice of Proposed Rulemaking" (ANPRM) or may be termed "Notice of Proposed Rulemaking" (NPRM). Interested organizations and persons are given an opportunity to participate in the rulemaking process through submission of written data, views, or arguments with or without opportunity for oral presentation. If the cognizant agency is required to hold a public hearing, interested organizations and persons may present testimony and exhibits that reflect their views and arguments for or against the proposed rule.

b. Source Reduction Review Project (SRPP). This new initiative is being established through a joint effort between EPA and DOD to evaluate pollution prevention alternatives during the development phases of new environmental rules. Its purpose is to support the use of source reduction measures in industry by firstly developing standards in new rules that can be met through source reduction, secondly developing regulatory incentives for adopting source reduction as an alternative means of compliance, thirdly providing guidance materials with final rules to educate permit writers and industry about the performance and cost of source reduction measures. After the new regulations have been developed they will be implemented, but EPA will offer assistance to aid industry in identifying and effect source reduction techniques.

2-2.2 State and Local Government Rulemaking Procedures. Usually, rulemaking in states and local governments follow the same general procedures as the Federal rulemaking process. The NPRM is published in a government publication; interested parties may submit their data, views, and arguments on the proposed rule, and hearings may be held.

2-3 NAVY RESPONSE/ACTIONS

The promulgation of proposed statutes, laws, rules, and/or regulations is not an overnight process. The time may vary from 24 to 60 months. Usually there is plenty of time to analyze the proposed rule, determine impacts, develop the response/control strategy, respond to the cognizant agency, attend hearings, develop POA&M, identify fund requirements, identify R&D requirements, and develop Program Objectives Memorandum (POM)

input. The key is for prompt action by appropriate organizations upon receipt or knowledge of the ANPRM/NPRM.

2-3.1 Federal Government Rulemaking. Response to proposed rulemaking in the Federal sector for the Department of the Navy will occur at the Assistant Secretary of the Navy (ASN)/Chief of Naval Operations (CNO) level and, as needed, the major claimant level. Key organizations responsible for developing and tracking Navy response actions include the following:

- Office of Legislative Affairs
- Assistant General Counsel (Installations and Environment)
- Assistant Secretary Of the Navy (Installations and Environment) and ASN (Environment and Safety)
- Deputy Assistant Judge Advocate General (Environmental Law) (NJAG-12)
- Deputy Chief of Naval Operations (Logistics) (N45)
- Major Claimants (Environmental and Hazardous Material POCs)

2-3.2 State/Local Government Rulemaking. Response to proposed rulemaking in the state and local governments centers around the organizations described in OPNAVINST 5090.1A, Environmental and Natural Resources Program Manual. ASN/CNO organizations cited above become involved whenever the state and local laws, rules, and regulations adversely affect the Navy mission, require special environmental legal assistance, and/or require exorbitant budgetary actions. Key organizations responsible (see Chapters 1 and 2 of OPNAVINST 5090.1A for duties) for tracking, impact identification, and development of response actions for state and local government rulemaking include the following:

- ASN/CNO organizations identified in paragraph 2-2.1 with the exception of Office of Legislative Affairs
- Major Claimants (Environmental and Hazardous Material POCs)
- Naval Facilities Engineering Command including Engineering Field Divisions (EFDs)
- Area Coordinators
- Regional Environmental Coordinators
- State Environmental Coordinators
- Commanding Officers of shore activities

2-3.3 Suggested Actions. There are many suggested actions that should be taken to ensure proposed rulemakings are adequately reviewed. The following are some suggested actions:

- Obtain and read the Federal Register or equivalent state/local publication

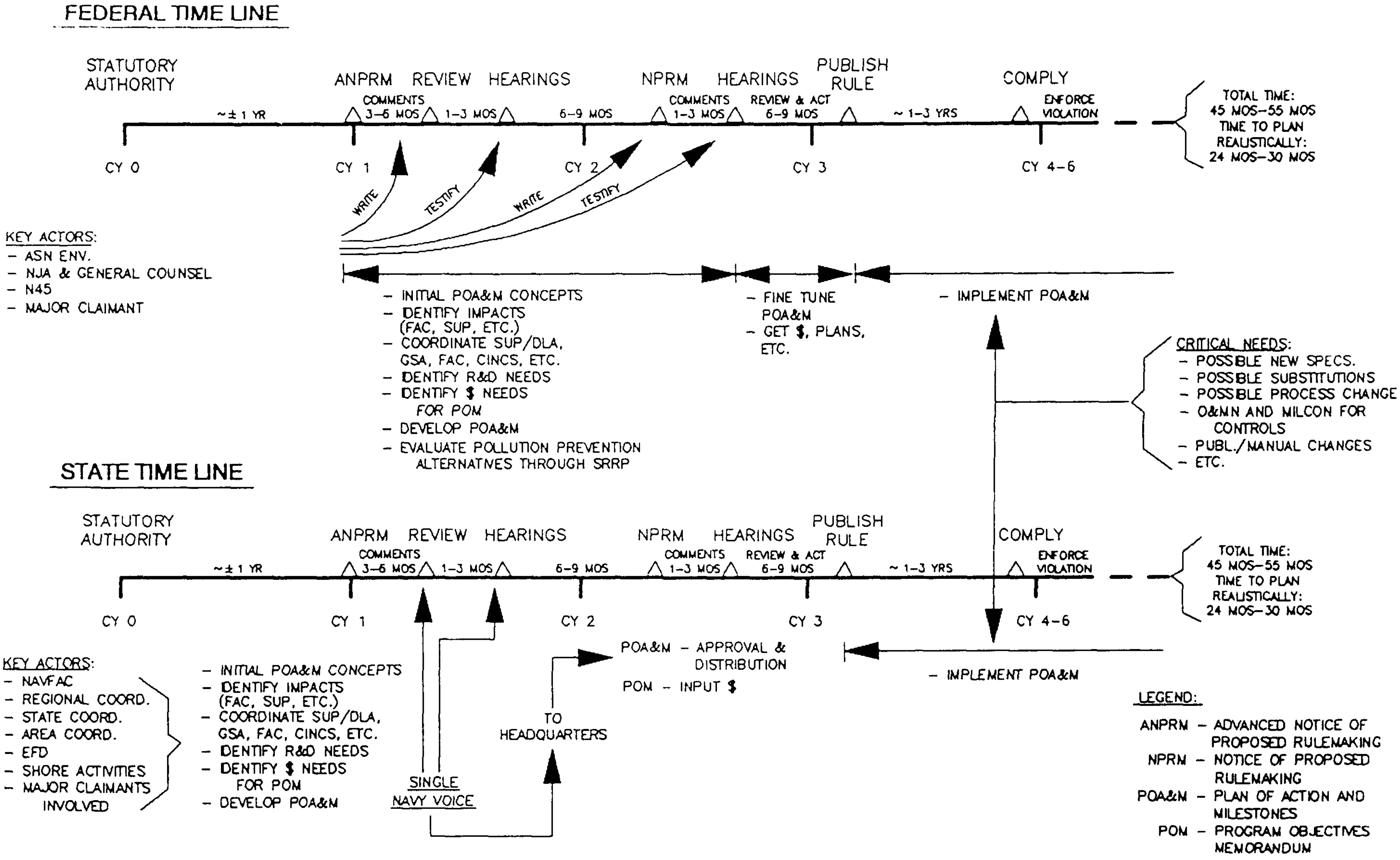
- Obtain copy of ANPRM/NPRM/proposed statute/law and analyze for impact (obtain assistance of Major Claimants, etc.)
- Develop response (positive or negative)
- Attend hearing (provide testimony if required)
- Identify RDT&E requirements
- Submit budget requirements for RDT&E
- Maintain continuous coordination with regulatory agencies
- Develop preliminary plan of action and milestones (POA&M)
- Identify funding requirements to comply (to include all appropriations) and prepare Program Objectives Memorandum (POM) input
- Submit POM
- Hold compliance planning meetings
- Develop compliance strategy (substitution, process change, administrative control, recycle)
- Identify construction requirements including control technology, MILCON, O&MN and OPN
- Finalize POA&M
- Implement compliance strategy
- Change manuals/publications as needed
- Change specifications as needed
- Initiate reporting as required by code, standard, or regulation

2-4 TIMELINE

There is a finite timeline for both the Federal and state/local rulemaking process. The timeline starts at the approval of the statutory authority and extends until compliance is mandatory and agency enforcement begins. This time varies and may extend up to six years; it may also be as short as three years as was the case in the California VOC rule. Figure 2-1 shows a schematic of possible timelines and actions to be taken to avoid regulatory impacts on both Federal and state/local rulemaking processes. It should be noted that the action times can be shortened or expanded depending upon the cognizant agency's actions. For example, an ANPRM may not be issued and the resultant timeline would be shortened by about 12-15 months. Generally, there is sufficient time for necessary planning to occur before compliance is expected. What is necessary is for prompt action to be initiated by the cognizant Navy organization as soon as the ANPRM/NPRM is announced.

FIGURE 2-1

TIMELINE CHART FOR ENVIRONMENTAL/HAZARDOUS MATERIAL REGULATORY COMPLIANCE



CHAPTER 3

THE HAZARDOUS MATERIAL SUBSTITUTION PROCESS

3-1 SCOPE

This (apter describes a generic HM substitution process. Togeth r with the other Chapters, it serves as a basis for a common approach for HM substitution actions by Echelon 2 Commands and as a guide for such actions by Acquisition Program Managers. Tailoring of the basic element descriptors in this Chapter should be accomplished to provide for specific individual organizations, provided the basic approaches are followed.

3-1.1 The Hazardous Material Substitution Process Chart. Figure 3-1 is a generic logic diagram for HM substitution procedures and actions. Figures 3-2 and 3-3 are two examples of the many different "paths" that may result in applying the process chart to specific substitution problems.

3-1.2 Relation to Process Changes. Although this Manual and this Chapter are primarily directed at material substitution, the basic principles and processes depicted in this Chapter are also applicable to "process" changes.

3-2 RELATION OF HM SUBSTITUTION TO HM/POLLUTION PREVENTION METHODS

The preferred approaches to HMC&M and pollution prevention as stated in reference (d) are consistent with the hierarchy stated in the Pollution Prevention Act of 1990. These are in priority order:

a. Eliminating and/or reducing the use of HM by a process or material change at the source.

b. Substituting a less hazardous material.

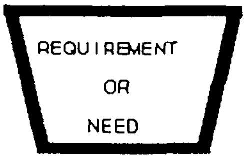
c. Recycling/recovery and reuse of HM.

d. Administrative/management procedures (e.g., shelf life extensions and allowable quantities on hand, etc.).

e. Combinations of the above.

f. Disposal in an environmentally acceptable fashion.

3-3 DESCRIPTION OF THE ELEMENTS OF THE PROCESS CHART



3-3.1 Requirements or Need. This is the starting point for the HM Substitution Process. The need for Navy substitution action arises from both generic and specific requirements.

3-3.1.1 Generic Requirements. Chapter 7 describes a priority system for generic action. The overall HM substitution policies and actions called for in DoD and Navy directives include:

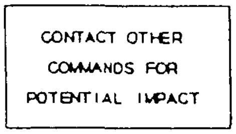
a. DODD 4210.15 requires the use of the least hazardous materials, consistent with cost and missions requirements.

b. DODI 5000.2 (Part 6, Section I) requires selection and use of the least hazardous materials. This document also requires special approval when military requirements call for use of high or serious risk materials.

c. The Navy priority scheme to adopt the EPA Industrial Toxics Projects (ITP) 17/33-50 groups of chemicals and the 10 to 20 items identified as the major HM "bad actors" described in Chapter 7 provides candidates for substitution actions.

3-3.1.2 Specific Federal, State, and Local Regulations. Chapter 2 discusses the impact of pending and actual Federal, state, and local regulations as generating a need for substitution actions. In many instances, the costs and other resource requirements of permits, recordkeeping, control measures, training, and potential liability can be avoided or minimized by taking timely substitution or process change measures.

3-3.1.3 Local Needs. Another major source of requirements or needs for substitution are locally generated actions which would require substitutions to be identified for either non-stock listed items or Federal stock listed items. As an example (consistent with OPNAVINST 4110.2.), a shipyard may need to compare the hazards and costs associated with the use of an alternative for glues used in the carpentry and wood shop. The substitution process chart would be utilized in order to explore substitution possibilities instead of using the hazardous materials and disposing any resultant waste as HW. Another source of "needs" is the identification by user personnel of possible substitutes based on local knowledge.



3-3.2 Contact Other Commands for Potential Impact. This block is one of the most important initial actions within the substitution process chart. (Note however, that this block is not shown as a "process delay point.") To ensure that problems do not occur between Commands, the Command sponsoring or identifying the substitution requirement and need should contact all other Commands concerning the requirement or need. The Command establishing the "need" or requirement should contact all Echelon 2 Commands, and cognizant In-Service Engineering Activities (e.g., the Ships Engineering Support Office (SESO), Aviation Supply Office (ASO), Naval Air Warfare Support Center, etc.). N45 should be contacted for information as to specific points of contact within the Navy and in other DoD components which may have similar problems.

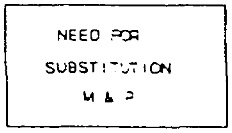
Potential impact problems, without such coordination, might be:

a. Deletion of a material used in other Echelon 2 Commands, for which a unique or special requirement exists.

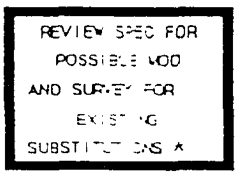
b. Substitution of a new material which meets one Command's needs and engineering requirements, but which is incompatible with materials authorized for another command.

c. Research and development or engineering development on a similar problem is already underway in another organization.

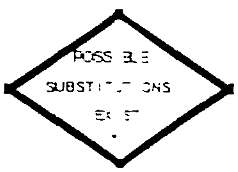
3-3.3 Operational Impact. This question addresses whether or not the basic material has a valid operational need. As an example, in the review of various specifications, a hazardous material might be identified that is no longer used in the Navy. As a result, the answer is "no," and further actions are to be taken to delete the requirement for that specification. The logical question associated with this decision block would be: "Is this material still in use?" Another question could be "Is it in use but other substitutes are already available and approved and its withdrawal would have no operational impact?" The answer would also be "no" with same follow on action. If the answer to the latter question were "yes" as for approved substitute materials in use, then the need would exist to determine their suitability as a substitute material. The "yes" answer to an operational impact question leads to the need for studies to find substitutes for materials and/or processes.



3-3.4 Need for Substitute Materials and Processes. The next step in the process is the generation of a "Needs" statement. It should clearly state the objective of the substitution action, provide a clear plan of the actions required, and identify milestones for the various elements of the process. Such a "statement" should indicate the organizations responsible to accomplish the necessary actions. Funding requirements should be identified. If there is an assigned Navy "lead organization" for the material for which substitution is needed (e.g., NAVSEA for the Ozone Depleting Chemicals Program), the Needs statement serves as a vehicle to establish the using Command's requirements with the lead organization. The Needs statement also includes identification by the originator of possible relationship of process changes to substitution. The possibility of a dual track approach should be considered.



3-3.5 Review Specifications. The next step in the process is to determine if the existing specification allows alternative material composition. The vast majority of Federal and Military Specifications are performance based. A number of National Stock Number (NSN) items meeting the specification may (and many do) have different compositions. In some instances, one of these may be a suitable candidate for substitution. In a number of cases, action may already been taken to provide an alternate specification to meet environmental regulations. As an example, GSA has published a list of low VOC paints and solvents which may or may not meet the follow-on steps of the substitution process.



3-3.6 Possible Substitutions Exist. Based on the results of the previous step, some existing NSN materials may be identified as possible candidates for substitution action. In addition, a wide variety of sources of possible candidates should be considered. These include advertisement for "environmentally acceptable" materials, contact with manufacturers, review of "Chemical Abstracts," and use of Command engineering resources. The previously stated need for contact with other Echelon 2 Commands plus contact with other military services, GSA, and DLA may identify potential candidates. A list of currently available "clearing houses" which may be useful, is provided as Table 3-1.

3-3.6.1 The substitution algorithm (Chapter 4) is a methodology using a step-by-step procedure comparing two or more HM. The results shall be used for entry into any decision analysis box of

the Substitution Process Chart. The algorithm provides a means for identifying "high" or "serious" risks requiring special approval per DoDI 5000.2. The algorithm assigns numerical "points" for such elements as toxicity, medical effects, duration of expected exposure, fire and explosion potential, etc.

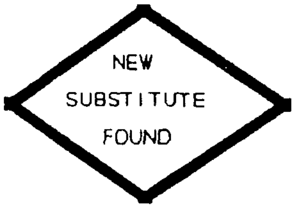
3-3.6.2 There may be candidates for replacement of an existing Navy Authorized Use List (AUL) item, a proposed replacement for an existing Department of Defense (DoD) Federal specification material, or in the selection of the least hazardous of two or more candidates for use in a new system. The algorithm methodology is not the sole determining consideration. It is intended for use as a screening device for ranking existing and/or proposed materials by their properties affecting health, environment, and safety. The points are totaled and used for comparison of one material's "Hazardous Material Selection Factor" (HMSF) with another (see Chapter (4)).

3-3.6.3 If no possible substitutions exist, the next step is the R&D box. If the answer is yes, then the next major block is identifying additional applications. As discussed in paragraph 3-3.2 above, if possible substitutions have been identified then other Echelon 2 Commands need to be contacted to see if the proposed best substitute may have other potential uses than those which the substitute is being examined or tested. Such contact also needs to identify if bringing this substitute into the system is going to create any new problems with the other Commands. This contact should also seek information as to whether or not the other Commands have potential substitutes which also might be considered.

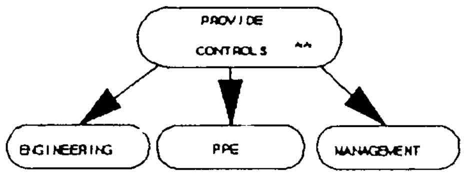
INITIATE
SUBSTITUTION
R & D

3-3.7 <u>Initiate Substitution R&D</u>. If possible substitutions are not found to exist, it becomes necessary to initiate a Research and Development (R&D) program to identify new potential material candidates. The R&D effort may be two-fold; it may be for an actual material development or R&D or it may be for new applications of an engineering development nature. It also may involve research on improved processes and procedures. In the case of new systems, the R&D process must be initiated so that results and decisions for new materials which have never been used before (such as synthetic carbon materials) are in phase with system acquisition milestones. Before initiation of R&D projects, contact other commands as in 3-3.1 above.

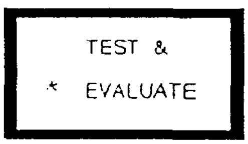
R&D is a lengthy and costly process; therefore, the initiation of the R&D requirements must include necessary funding options to accomplish the R&D.



3-3.8 New Substitute Found. If the R&D effort results in new candidates for substitution, then the substitution process proceeds to the "test and evaluation" block. If no candidates are found, then the process proceeds to the "provide controls" block.

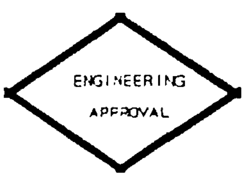


3-3.9 Provide Controls. If R&D does not identify new candidates, then the block to "provide controls" becomes a very important block. As indicated with a double asterisks, it becomes necessary to obtain engineering approval for the non-stock number items. Furthermore, the existing material, such as a VOC material for which there is no substitute, may require extensive engineering for environmental compliance controls beyond those already in use; and/or may require additional personal protective equipment to meet OSHA requirements. Continued use of the material also may require additional management considerations such as application for permits or changes for operating procedures, to meet new regulatory requirements. These include those associated with the Federal Facilities Compliance Act of 1992, Clean Air Act Amendments of 1990, and other similar changes.



3-3.10 Test and Evaluation. Determination of suitability of the candidate material to satisfy Navy needed or intended use is a major element of the substitution process. There are two major aspects which are included in the Test and Evaluation (T&E) plan. These are engineering evaluation, and assessment of life cycle costs. T&E includes both laboratory testing and field engineering studies. It may be a lengthy process and also may require resources for which funding should be anticipated in the "Needs" statement.

Note: The substitution process recognizes that the nature of Navy operational and maintenance functions is such that in some instances the least hazardous material identified by use of the algorithm will not meet such needs.



3-3.11 Engineering Evaluation. The engineering evaluation is in effect a feasibility study using the results of the "test and evaluation" block. Among the issues which are to be addressed are:

a. Does the material meet required performance standards, as well or better than use of the existing material?

b. Is its durability/mean time to failure satisfactory from a mission and operational suitability viewpoint?

c. Does it create a new hazard (e.g., such as substituting a lower toxicity material that has a fire hazard, for a higher toxic one without such hazard)?

d. Will the new material's use adversely affect scheduled maintenance or operational cycles?

e. Does it create a requirement for major process or equipment changes?

f. Is it compatible with the working surface/equipment used on or with the material?

Note: In the event the Engineering Evaluation results in a finding that the proposed substitute is not satisfactory, the next element is "Another Substitute Available?" Generally there would be two more possible substitute candidates. In that event, the Test and Evaluation process would be reinitiated for the next most desirable substitute. If all possible substitutes fail the engineering evaluation, or there is none, then Research and Development is initiated again (see paragraph 3.3.7) or approval for continued use of the existing material is requested of the appropriate decision authority. In the event of approval, then any required controls to meet current codes, standards and regulatory requirements must be provided.

LIFE CYCLE COST ANALYSIS

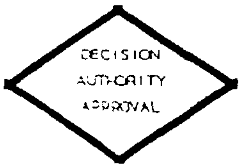
3-3.12 Life Cycle Cost. A Life Cycle Cost (LCC) estimate is required for both the currently used HM and the proposed substitute or for the two most likely candidates where no existing material is being considered. The LCC estimate should be commensurate with the scope of the hazard and intended use of the HM (see Chapter 5).

3-3.12.1 At a shore activity considering a substitute for a local use material (such as paint) the LCC estimate begins with initiation of procurement, its receipt, storage, issue, use, and disposal. Among the costs that should be included are any work place monitoring, training, personal protective equipment, work place controls, and disposal.

3-3.12.2 In the case of HM associated with a new or modified weapon system (e.g., an auxiliary propellant for a subsystem),

such considerations as the cost of obtaining the material, transportation, installing the specialized equipment, testing and monitoring, spill clean-up, etc., have to be accounted for and documented. Also the costs associated with the depot maintenance of the weapon system due to the presence of the material have to be included in the estimate. The LCC estimate determination must cover all HM related costs for each Weapon System Acquisition phase, from Milestone 0 to ultimate disposal of the systems.

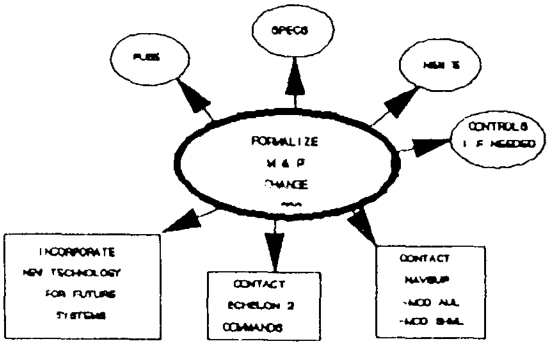
3-3.12.3 If the LCC estimate does show an increase in the cost of a proposed substitute over the in use or base material or the proposed substitute over the next likely candidate, the matter will have to be referred to the appropriate decision authority. Even if there is no life cycle cost increase, if the proposed substitute is a "serious" or "high risk," approval will also have to be obtained. If the best item is more costly but still does the job as well and appears to be the most useful from the Navy's viewpoint, it will have to be referred to a higher authority through the SYSCOM to DCNO Logistics for approval. (There is a major need for "decision authority approval" if the best material is also more costly.)



3-3.13 Decision Authority Approval. The "Decision Authority Approval" for less than "high" or "serious" risk HM will vary from Command to Command. It should be designated in any Echelon 2 implementing instructions. For "high" and "serious" risk materials, even if less hazardous than existing items, the requirements of DODI 5000.2, Part 6, Section I, are to be met. Approvals for use of "high" and/or "serious" risk hazards must be obtained as described in paragraph 1-2.2. (Depending upon the organization and delegation of the command, the "decision authority approval" may be "engineering approval.")

3-3.13.1 Resource Requirements-POM Action. In the majority of cases, substitution actions generate additional resource requirements. Because of the lead time to obtain approval in the Navy's budget, any such needs should be identified as soon as possible and action taken for inclusion in "Program Objective Memorandum" (POM). Such needs are those identified in the "Formalize M&P Changes" block.

3-3.13.2 Documentation. Chapter 8 provides guidance for documenting requests for approval.



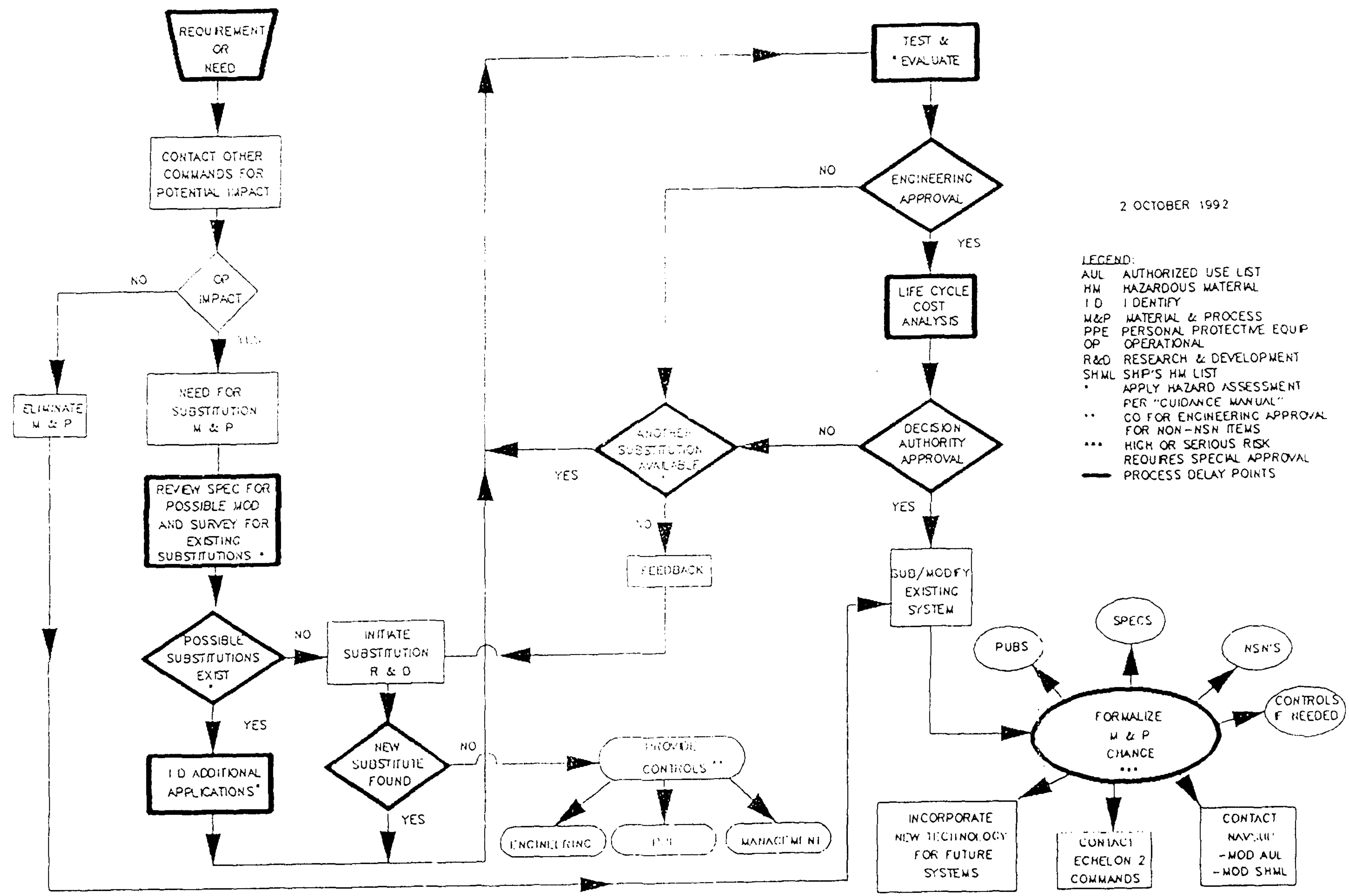
3-3.14 <u>Formalize Material and Process Change</u>. The end of the substitution process involves a wide variety of implementing actions.

3-3.14.1 Coordination with NAVSUP is essential to ensure that the necessary planning and actions to phase out procurement of the current material and phase in procurement of the newly authorized one. Such planning and action is also needed to update the SHML and/or AUL for inclusion of new National Stock Numbers (NSN).

3-3.14.2 Changes to all maintenance and other documents specifying the use of the current material have to be made. Otherwise, since such are the "controlling documents," continued procurement and use by using organizations will occur.

3-3.14.3 A substitute material may, and many will, still require controls to comply with environment, safety, and health requirements. These must be identified, planned for, and be in place concurrent with the availability and use of the new material. Any new training requirements must be identified and accomplished in advance of issue of the new item.

HM SUBSTITUTION PROCESS



HM SUBSTITUTION PROCESS

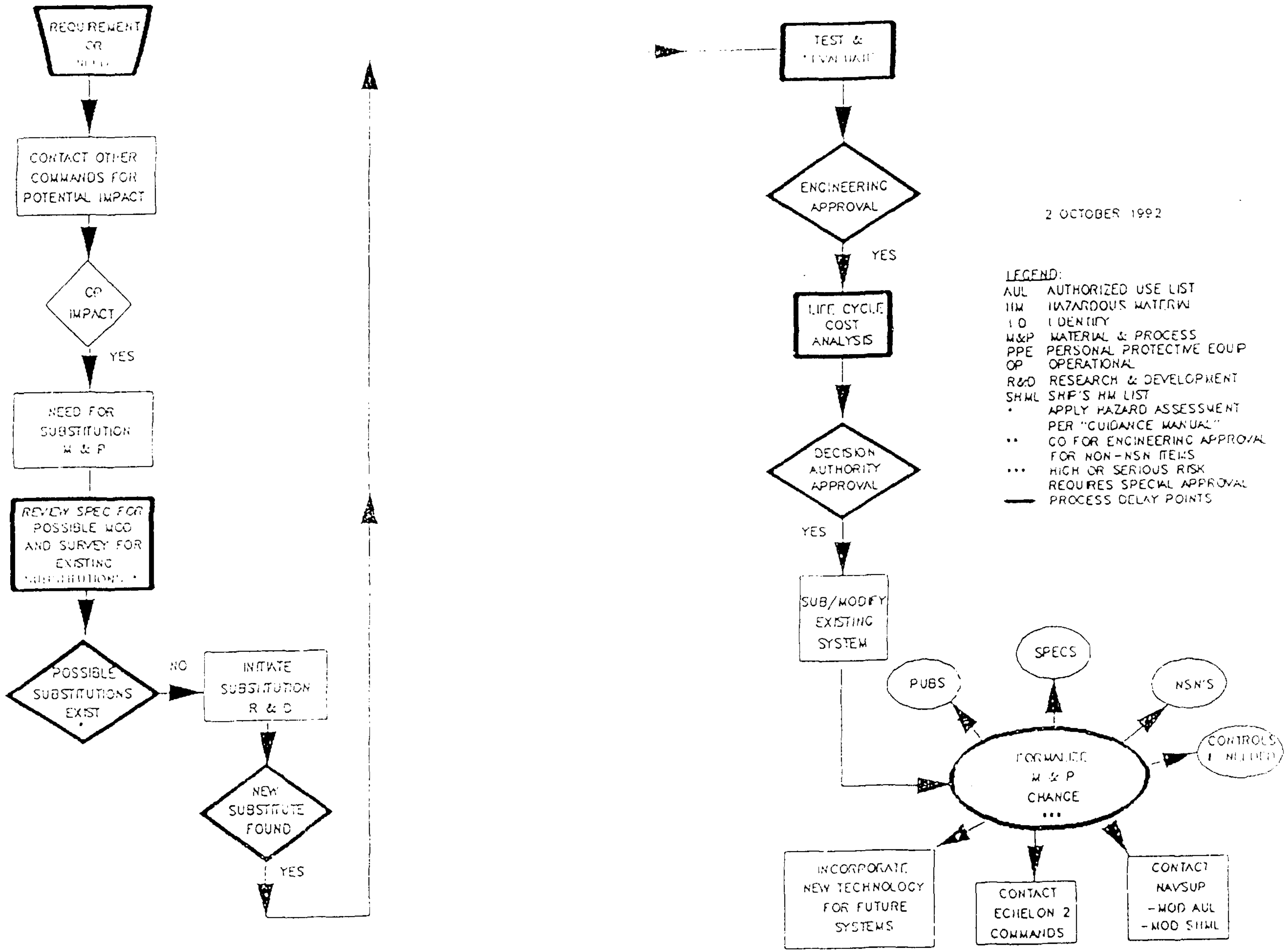
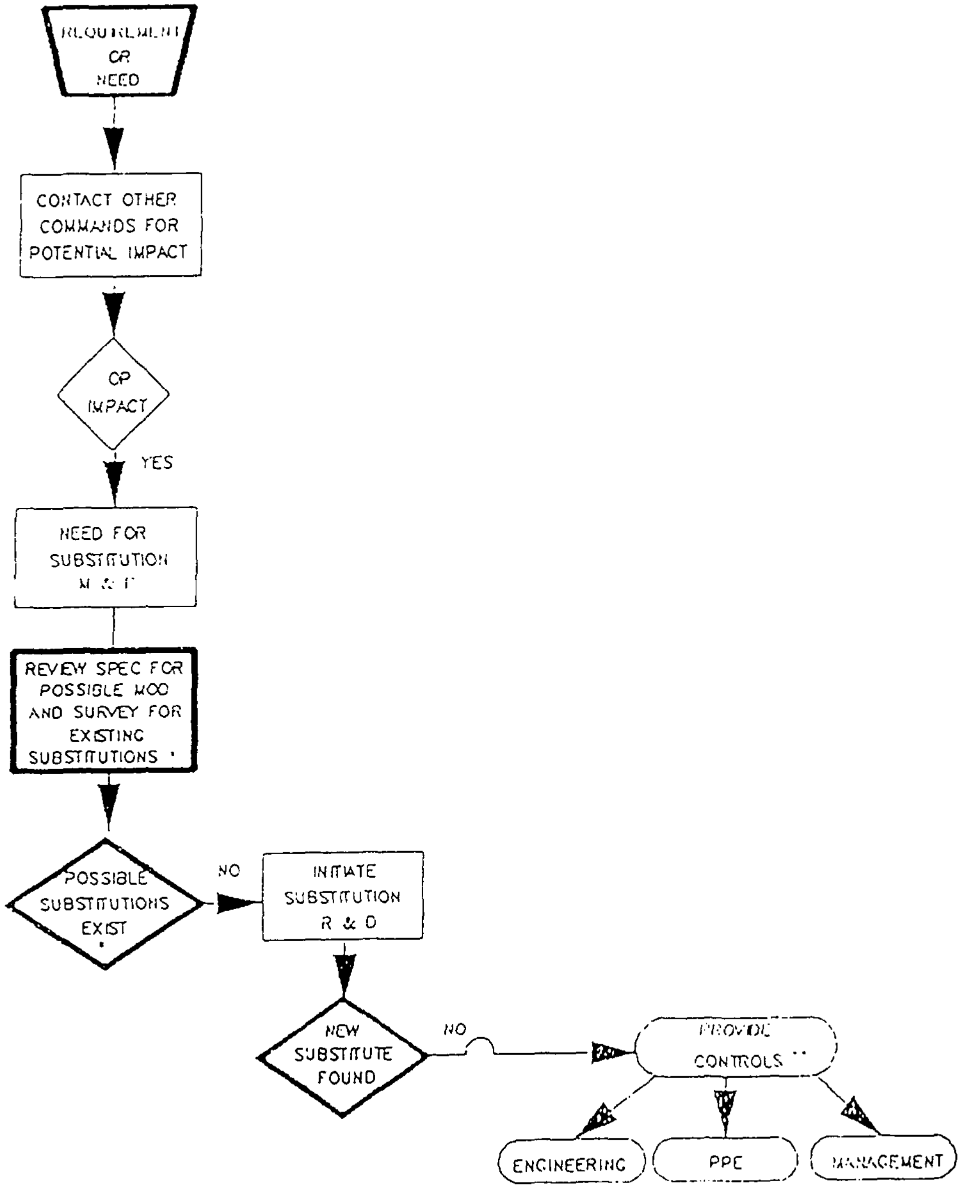


FIGURE 3-3

HM SUBSTITUTION PROCESS



2 OCTOBER 1992

LEGEND:
AUL AUTHORIZED USE LIST
HM HAZARDOUS MATERIAL
I D IDENTIFY
M&P MATERIAL & PROCESS
PPE PERSONAL PROTECTIVE EQUIP
OP OPERATIONAL
R&D RESEARCH & DEVELOPMENT
SHML SHIP'S HM LIST
* APPLY HAZARD ASSESSMENT PER "GUIDANCE MANUAL"
** GO FOR ENGINEERING APPROVAL FOR NON-NSN ITEMS
*** HIGH OR SERIOUS RISK REQUIRES SPECIAL APPROVAL
—— PROCESS DELAY POINTS

CHAPTER 4

SUBSTITUTION/SELECTION METHODOLOGY FOR LESS HAZARDOUS MATERIALS

4-1 SCOPE

This Chapter provides guidance and step-by-step procedures to compare two or more hazardous materials (HM). These HM may be candidates for replacement of an existing Navy Authorized Use List (AUL) item, a proposed replacement for an existing Department of Defense (DoD) Federal specification material, or in the selection of the least hazardous of two or more candidates for use in a new system. Another purpose of this Chapter is to provide a means for identifying "high" or "serious" risks requiring special approval per DoDI 5000.2, System Acquisition Management Policies and Procedures (Part 6, Section I). The methodology described herein is not the sole determining consideration in a substitution action. The substitution algorithm is intended for use as a screening device for ranking existing and/or proposed materials by their properties affecting health, environment and safety. The resulting ratings may be included in decision models along with other decision factors, e.g., use suitability analyses, mission needs analyses, economic evaluations, etc., as discussed in the HM substitution process described in Chapter 3.

4-2 OVERVIEW OF METHODOLOGY

4-2.1 The Substitution Algorithm. The methodology consists of an algorithm which is used to assign numerical "points" for such elements as toxicity, duration of expected exposure, medical effects, fire and explosion potential, numbers of personnel affected, and a limited assessment of environmental control and impact. The "points" are totaled for each candidate material, thereby providing a numerical score called the "Hazardous Material Selection Factor" (HMSF) and a Risk Assessment Code (RAC) number. This allows for comparison of one material's HMSF with another. The results can also be used for entry into any decision analysis procedure. The step-by-step procedure for assignment of points and developing the HMSF is provided in Appendix A. A worksheet and examples of use is in Appendix B.

4-2.2 Basis For The Methodology. The methodology in this Chapter is based on the current RAC specified in DoDI 6055.1, DoD Occupational Safety and Health Program, MIL-STD-882, System Safety Program Requirements, MIL-STD-1388-1A, Logistic Support Analysis, MIL-STD-1388-1B, DoD Requirements for a Logistic Support Analysis Record, and OPNAVINST 5100.23, Navy Occupational

Safety and Health (NAVOSH) Program Manual, etc. Adaptations have been made to the procedures in DoDI 6055.1 to include environmental attributes and to establish a rating system compatible with the requirements for identifying "high" and "serious" risks as called for in Part 6, Section I, DoDI 5000.2.

4-2.3 Hazardous Material Descriptors. The methodology described in this Chapter is intended to be used without in-depth references to standard texts on toxicology, environmental effects, physics, and chemistry. Such references should be consulted when more than a screening is required. The services of professionally qualified industrial hygienists, toxicologists, environmental engineers, and scientists should be utilized when more detailed analysis and assessments are needed. A brief summary of hazardous material descriptor information for users' better understanding of general concepts and terminology is provided in Appendix C.

4-2.4 Basis for the Algorithm "Points." The following information is provided to assist in applying the rating "points" of the algorithm methodology.

a. Toxic Effects.

(1) The evaluation should include the frequency and duration of possible worker exposure. This includes whether the material presents toxic hazards on brief, short term exposures associated with high concentrations and accidental releases, or primarily causes harm from extended exposure to relatively low concentrations. Materials which are skin irritants, sensitizers, carcinogens, and/or teratogens and mutagens require special attention even if the projected quantities are small.

(2) In many instances, the material safety data sheet (MSDS) will only summarize the toxicity data of the individual components of the mixture and will not provide information concerning specific toxicological studies on the material itself. In such cases, judgements will have to be based on consultation with such approved sources as the Navy Environmental Health Center. Attention also must be given to any information indicating that the material is a known skin sensitizer or possesses allergenic properties. A suggested source of reference regarding toxic hazards is the "NIOSH Pocket Guide to Chemical Hazards" available from the US Government Printing Office.

b. Physical Characteristics. Materials with a high vapor pressure are more likely to be easily dispersed into the environment than those with lower ones. Those with low flash and low boiling points (flash point lower than 73°F and boiling point

below 100°F) are extremely hazardous from a fire and explosion viewpoint as contrasted with those with flash points greater than 100°F. Liquids with specific gravities less than 1.0 present fire-spreading hazards because such materials float on water. A "toxic material" with a high vapor pressure is more of a hazard in a confined work area than one with the same toxic properties with a much lower vapor pressure. This is because the higher vapor pressure will afford a greater risk of room atmospheric contamination.

c. Chemical Characteristics. Among the chemical characteristics which must be considered are stability, reactivity with other chemicals (for example, is the material an oxidizer or corrosive), and solubility, not only in water but in other media. Where mixtures are involved, it is important to understand that those with organic chemicals of the "aromatic" type are generally more toxic (and often possess greater fire and explosion hazards) than those classed as "aliphatic" chemicals.

d. Circumstances of Exposure.

(1) In addition to the specifics of a particular work area(s), questions on the distribution of materials required for use throughout the weapon system life cycle or at a shore activity need to be considered. Localized use (in a single work area) of a material determined to be highly hazardous presents a different set of concerns when arriving at approval decisions than those that apply to one which is widely used with moderate hazard potential. Among the considerations that should be examined are: size of the work force or number of persons at the work site; present and/or needed engineering or other controls; and work area environmental conditions which affect the hazard (temperature, humidity, other chemicals which may be synergistic or additive, etc.).

Note: For new system acquisitions, data on size of work force may be minimal or only available by comparison with existing analogous naval weapon systems.

(2) During a general review and evaluation of a proposed material, questions need to be examined on the interaction of the proposed material with others already approved and its use in the system or work areas and with nearby operations. For example, it would be a mistake to approve a new cleaning solvent with a high vapor pressure and low flash point for use in areas with volatile organic compound (VOC) restrictions or shops in which high temperature work (i.e., arc welding) is conducted.

(3) When evaluating compounds containing a mixture of chemicals, the mixture shall be assumed to present the same health hazards as do the components which comprise one (1) percent (by weight or volume) or greater of the mixture except for carcinogenic materials. If a mixture contains a component that is a carcinogen, then that mixture shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater (by weight or volume). When evaluating mixtures, select the component with the lowest listed PEL or TLV value. Use this value to determine the points awarded for exposure restrictions.

e. Environmental Implications. The potential for hazardous waste (HW) generation and compliance with various Federal, state, and local codes, standards, and regulations must be evaluated. In some geographical areas, regulations on use and/or release of volatile organic compound air pollutants are very severe and may require special controls. Similar concerns must be examined with regard to air and water quality and permits required for allowable emission of contaminants into air and water sources. The need for accomplishing environmental assessments and/or environmental impact statements is another requirement that must be considered. Because of the wide variety of such requirements, the "points" utilized in this method are simplified. More detailed ratings may have to be developed for some analyses, particularly if there is no significant "point spread" between candidate hazardous materials.

4-3. PREPARING FOR USE OF THE ALGORITHM

4-3.1 Identification of Information. Users, before applying the algorithm method for a specific analysis of two or more candidate hazardous materials (including an existing one or two or more possible substitutes), should:

a. Obtain accurate input data for each candidate material. One source is the current MSDS from the manufacturer. Another source is the Hazardous Material Information System (HMIS). If this is used, verify the correct vendor and date of the latest revision for the MSDS. Many HMIS entries contain out of date information and cannot be used. The U.S. EPA "Title III, List of Lists" (EPA publication 560/4-90-011, Jan. 1990. or latest edition) is available from EPA in hard copy and disk formats. It contains information for the "reportable quantities (RQ)" element in the Environmental Impact Evaluation portion of the algorithm. The user should also consult state and local environmental regulatory requirements. Assistance for these can be obtained from the Federal Facilities Office of the EPA Regional Offices, listed in Appendix B of OPNAVINST 5090.1A.

b. For existing operations and processes, data on the size of the work force, etc., specifics of the operation and existing controls (or lack of) should be reasonably available. Technical/maintenance manuals are also important sources. For a system acquisition, possible changes in circumstances in each development/acquisition phase must be identified. The user should obtain details from the Program Manager. In many cases, the analysis will be conducted by the system contractor and must take into account both production and later operational conditions.

c. Identify needed control measures and precautionary procedures for the selected material and for the documentation of the rationale for selection and approval of "high" and "serious" risk material.

4-4 APPLICATION AND USE OF THE METHODOLOGY

4-4.1 Selection of Candidates for Analysis. Chapter 3 discusses the Substitution Process, including the identification of "needs" for substitution. Once such a need has been identified, the cognizant claimant or program office is faced with the problem of identifying potential candidates to replace an item already in the system (e.g., on the SHML or AUL), or potential items for new uses (e.g., a new bonding agent for synthetic materials being developed for a new weapon system). At present, there is no central source of information on potential candidates. Personnel responsible for identification of materials which may meet functional requirements and have the potential for meeting engineering suitability requirement should consider the following sources:

a. Materials known to be used in similar applications.

b. Review of professional and trade journals, including articles and advertisements.

c. Review of data in Chemical Abstracts.

d. Contact with other Claimants.

e. Use of a "Sources Sought" advertisement in the Commerce Business Daily.

f. Contact with the R&D and Engineering communities within the Navy and other services.

g. Establishment of a Research and Development project

Note: For new systems this may be a basic approach as part of the system life cycle and in phase with the milestones.

4-4.2 Reproduction of Worksheets. Local reproduction of worksheets, either in hard copy or as computer generated spreadsheets, is authorized.

CHAPTER 5

LIFE CYCLE COSTS AND ECONOMIC ANALYSIS

5-1 SCOPE

This Chapter provides information on life cycle costs (LCC) and economic analysis procedures for decisions on hazardous material substitution. DODD 4210.15 and OPNAVINST 4110.2 require such analyses. These are to be appropriate to the magnitude of the problem and the scope and extent of the impact of the decision as to approval of use of the HM or its substitute. This Chapter provides guidance for the life cycle cost decisions identified in Chapter 3, "HM Substitution Process." It does not contain detailed instructions on life cycle cost and economic analysis methodology. These are contained in other publications, such as NAVFAC P-442 "Economic Analysis" and the references cited in this Chapter.

5-2 GENERAL GUIDANCE

5-2.1 Magnitude of Analysis. The nature and extent of analyses for HM decisions is to be tailored to the decision involved. The same principles as stated in DODI 5000.2, Part 4, Section E, apply, both for new system acquisitions; and for fielded-operational systems.

a. For example, consider the analyses to support a decision at a Public Works Center for substitution of a less hazardous glue than one used in the Carpentry Shop; as compared with those to support the decisions by an Echelon 2 Command for the less hazardous of several possible bonding materials for synthetic components and carbon fiber materials used Navywide. In the PWC case, a very simplistic approach can be used. In the latter one, much more complex elements of costs have to be examined.

b. Only the "sensitive" cost factors should be considered. These are those in which small changes have a demonstrable effect on the results. If, for example, a cost factor is so small as compared with others' contribution to total costs that a large change will not materially affect the total, then the analyses should not include them.

c. For weapon system acquisition, maximum use should be made of the existing HM cost data inputs available from the Logistic Support Analysis Record (LSAR) MIL-STD-1388-2B. The principal relevant elements are listed in Table 5-1.

5-2.2 Relation of Life Cycle Costs and Economic Analyses.

a. HM life cycle costs are those direct and indirect costs associated with the presence, use, and disposal of HM. They may include such cost factors as procurement, transportation, storage, receipt and issue, training, treatment, inventory control, hazard assessment and workplace monitoring; physical exams and treatment of illness and injury; spill contingency planning and reaction; permits; and liability.

(1) For a weapon system, these costs must be assessed over the entire life cycle, (e.g., Phase 0, "Concept Exploration and Definition" through Phase IV, "Operations and Support and Ultimate Disposal").

(2) At a shore activity, for local substitution actions, the life cycle begins with the initiation of supply action and extends through subsequent receipt, storage, issue, use, and final disposal.

(3) LCC are to be developed for each feasible HM substitution alternative, including the presently used HM (if one is currently authorized and in use).

b. Economic analyses are evaluations of the LCC associated with the several alternatives for substitution in and by themselves. Economic analyses are one of several tools in the ultimate decision process. Cost benefit analyses are a form of economic analysis. Although a basic guide for economic analyses is contained in NAVFAC P-442, it, like all other models, does not provide a step-by-step procedure which applies to all evaluations and decisions as to use of hazardous material alternatives. Regardless of the technique used, the following should apply:

(1) A systematic approach must be used to facilitate selection of the most efficient and cost effective alternative. The most simplistic is a cost benefit analysis.

(2) Determining life cycle costs is less difficult in most cases than determining "benefits." The "benefits" are results in terms of goals or objectives. In the case of HM substitution, it may be difficult to assign a dollar value to some indirect benefits, such as avoidance of fees for permits and costs of litigation.

(3) Figure 5-1 depicts the basic elements of economic analysis, regardless of the formula or methodology used. The overall objective is to identify benefits or outputs versus costs

of feasible alternatives. If a proposed substitute material is not readily available or is in the process of development, it is not a feasible alternative substitute.

(4) The present Navy database of both costs and benefits associated with HM requires that the most sensitive cost and benefit elements be identified, and only these used. Indirect costs and benefits (e.g., the value of the benefits in avoiding law suits for damages from spills of HM) require best estimates as to "could cost."

(5) Because of difficulties in determining the value of "benefits," the most suitable approach for most HM substitution analyses may be to compare the life cycle savings of one alternative versus another (using suitable financial discounting procedures as described in P-442).

5-3 LIFE CYCLE COST MODELS

Life cycle cost analyses include the cost of original investments (e.g., procurement of HM, construction of storage or controls, etc.) and recurring annual operations and maintenance costs, incurred or projected to be incurred, from time of earliest entry of the material(s) throughout the life cycle from that point through use and disposition (see Figure 5-2). Life cycle cost (and benefits) are expressed in constant base year dollars. One model developed by the Navy Health Research Center for HM studies is provided as Appendix D. Regardless of the methodology/model used for either weapon system or local use as indicated above, the analyst should select the most sensitive or most readily available cost data.

5-4 SUGGESTED DOCUMENTATION OUTLINE FOR HM ECONOMIC ANALYSES

Chapter 8 provides guidance for preparation of documentation on the overall substitution process. The following are suggested contents for reports on economic analysis/cost benefit studies, supporting the overall decision document.

5-4.1 Objective, Assumptions, and Alternatives. State clearly the objective of the analysis (e.g., assist in determining the cost effectiveness of substitute HM as compared with currently used). Describe the alternatives, including the status quo. Explain how possible substitutes were identified. Include any assumptions (e.g., the substitute candidates will be available in a timely fashion, etc.). Include in assumptions, any relevant future regulatory impacts.

5-4.2 Cost Estimates. Describe the LCC estimate method used. Discuss the cost factors selected, source of the data, rationale for selection, and any uncertainties and their impact on results. Provide tables of discounted costs analysis for each alternative.

5-4.3 Determination of Benefits. State the criteria used to measure benefits or savings. If savings are used as benefits, state the basis. If benefits cannot be measured, provide a rationale for the subjective expert opinion. Include, if appropriate, nonmonetary benefit statements. These may include improvements to community relations, avoidance of mission degradation, and similar aspects. Provide a table of benefits for each alternative.

5-4.4 Time Dependent Considerations. Discuss all time dependent considerations. For a weapon system, these include the relative cost factors for each of the phases in system acquisition. Impacts of time to drawdown existing stocks of a HM being substituted should be identified and included in costs. Other time constraints which affect costs or savings should be clearly stated.

5-4.5 Sensitivity Analysis. Describe any relevant sensitivity considerations beyond those stated in 5-4.2.

5-4.6 Ranking and Selection of Alternatives. Provide a tabular comparison of costs and benefits (or savings) ranking in descending order with the most benefits or savings listed first. A narrative discussion of recommendations should be included, If, for example, the benefits or savings of the preferred alternative exceed costs or are based on significant other justifications, a complete discussion must be included showing the recommended action is feasible.

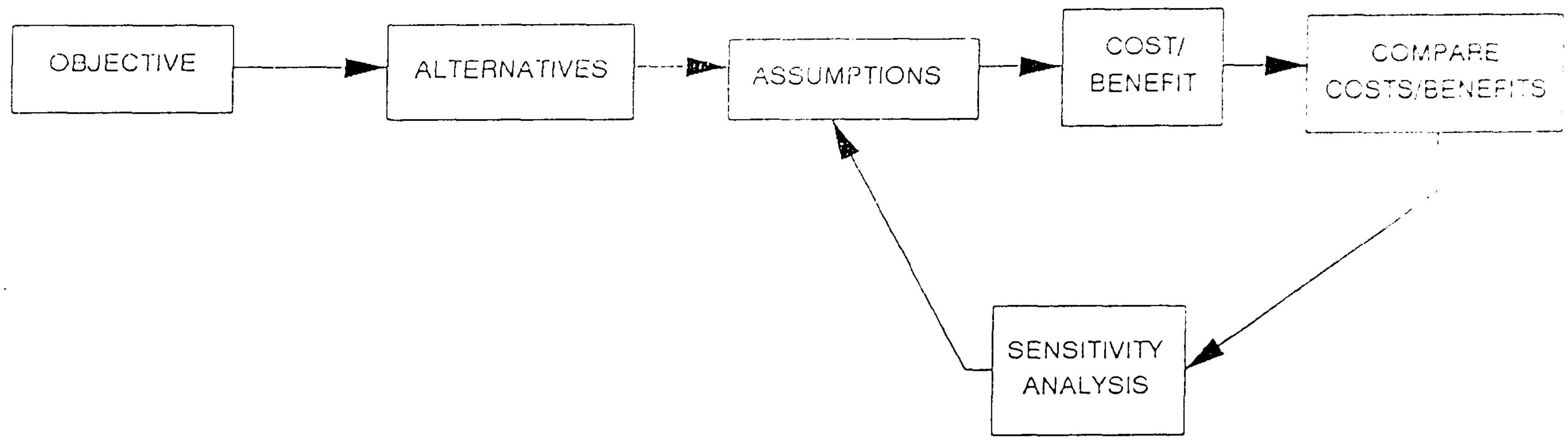
TABLE 5-1
PRINCIPAL COST ELEMENTS (HM/HW)
IN MIL-STD-1388-2B

Title	Identification #
Hazardous Material Summary (Identifies all HM for an end item and costs)	LSA 078
Hazardous Material Storage Costs (Costs in dollars to store HM)	DED 156
Hazardous Waste Disposal Cost (Projected annual cost to disposal of HW)	DED 157
Hazardous Waste Storage Cost (Projected annual cost to store HW)	DED 158

Note: LSA = Logistical Support Analysis Record Number
DED = Data Element Descriptors

FIGURE 5-1

THE ECONOMIC ANALYSIS PROCESS



SOURCE: NAVFAC P-442, ECONOMIC ANALYSIS HANDBOOK, JUNE 1986

LIFE CYCLE HAZARDOUS MATERIALS COSTS/COST AVOIDANCE CONSIDERATIONS

- Acquisition
- Supply and Storage
- Application
- Waste Treatment
- Other Disposal
- Emission Control
- Inventory Control
- Engineering/Process Control/Change
- Training
- Safety
- Hazard/Risk Assessment
- EA/EIS
- Permits
- Personal Protection
- Medical Monitoring
- Spill Prevention and Control
- Regulatory Overhead
- Liabilitv

Figure 5-2

CHAPTER 6

REPORTS AND MEASUREMENT OF PROGRESS IN SUBSTITUTION

6-1 SCOPE

This Chapter provides guidance for interim measurements of the overall HM substitution actions described in this Manual. It presents background and suggested methods to assess progress only at Navy Industrial Fund (NIF) activities, pending establishment by DoD and the Navy of a uniform procedure.

6-2 BACKGROUND

6-2.1 It is difficult, if not impractical, in the foreseeable future to directly correlate progress on substitution of HM with progress in meeting the DOD/Navy stated goal of 50% reduction in HW. This is so because of the long lead time between initiation of a substitution action and the resulting change in procurement and use. Moreover, the substituted material, while less hazardous, may or may not result in a lesser volume of waste.

a. The diverse nature of Navy industrial type operations and their essentially "intermittent job shop nature" precludes direct measurements of changes in waste streams from various pollution prevention actions, as is the case with a typical industrial production facility. Direct application of the measurements methods required by EPA's Form R, and the Biennial Report (40 CFR 262.41), without some modifications presents significant difficulties. Enactment of the Federal Facilities Compliance Act of 1992 requires Navy shore activities to submit these "Reports." Thus, some gross chemical specific comparisons based on the reports are possible and should be considered by local activities.

b. Despite the recognized difficulties, there are needs for application of interim measures of "indices" of success. These include: assessment of progress against mandated regulatory requirements including state regulations described above; determination of needs for programming or reprogramming required HM substitution resources; and establishment of credible evidence of progress on the Navy's commitment for environmental excellence.

c. There are three possible approaches for use in measurement of Navy progress on HM substitution. These are:

(1) A Total Quality Leadership (TQL) Level of Effort Method. This is in effect a self-audit by shore activities and System Commands, concerning progress in meeting self-established goals.

(2) Use of selected EPA Form R and Biennial Report Data as required by OPNAVINST 5090.1A. A specific category on HM substitution is called for in these reports.

(3) Compare year-to-year procurement data for the "Target Materials" specified in Chapter 7. Initially this data would be only from NIF activities, with results each year normalized by a common denominator (1000 labor hours).

6-3 NAVY-WIDE MEASURE OF SUBSTITUTION ACTIONS

6-3.1 <u>Responsibilities.</u>

6-3 1.1 NAVFACENGCOM is assigned responsibility (paragraph 9-6, OPNAVINST 5090.1A) for preparing the annual Navy Hazardous Waste Minimization Report. That "Report" is developed by NEESA. Effective 1 July 1992, Navy shore activities meeting criteria are to submit to NEESA a copy of the EPA Toxic Chemical Release Form R provided to EPA (paragraph 9-5.10 (a), (g) and (h) OPNAVINST 5090.1A). Shore Activities also are required to provide NEESA with copies of their Biennial EPA Form 8700-13 A/B or the comparable state form.

a. Both of the above cited forms require specific information as to substitution actions taken and comparison using a common denominator with previous year experience.

b. Pending development of a more suitable measure, NEESA will consolidate information on substitution actions reported by shore activities (as modified in paragraphs 6-3.1.2 & 6-3.1.3 below). This consolidated information as to progress on substitution is a surrogate for overall information. It is to be included in the annual "Navy Hazardous Waste Minimization Report."

c. Information provided NEESA concerning substitution actions taken by the cognizant major claimants is also to be summarized in the annual "Report."

d. Information on procurement data for the HM identified in Chapter 7, provided by Echelon 2 Command for NIF facilities will also be included. A comparison should be made with a base year, normalized by a common denominator (1000 labor hours).

6-3.1.2 Major Claimants with Substitution Responsibilities. Include in the annual report to NEESA information on substitution actions initiated and procurement of HM identified in the initial "target Chemicals" in Chapter 7.

6-3.1.3 Commanding Officers Shore Activities Required to Submit EPA Forms R and or 8700-13 A/B.

a. Enter the appropriate Codes for Source Reduction Activities, as called for in EPA Form R.

b. In Section 8.11 of Form R regarding "Additional Information," check "yes" and provide the following in the narrative:

(1) Indicate if the substitution action or process change was locally initiated or a result of a specification or other action by higher authority.

(2) Describe the Production or Activity Index used to determine the change from prior year, as called for in EPA Form R.

CHAPTER 7

HAZARDOUS MATERIAL SPECIFICATION REVIEWS

7-1 SCOPE

This Chapter describes the initial priorities for review of procurement specifications (Federal Specifications, military specifications, and commercial item descriptions) and related documents for possible HM substitution. These later include, Navy Maintenance requirement plans, Maintenance requirement cards, technical manuals, and other technical "controlling documents." Such action is among the "needs" described in Chapter 3. It constitutes a key component of the plan to review specifications to determine if changes are needed to reduce HM and generation of HW called for in OPNAVINST 4110.2. It recognizes that most specifications are performance oriented, and that the corresponding National Stock Numbers meeting the specification may, and often do, contain different HM.

7-1.1 Initial Effort. Initial specification review action will be directed at those specifications associated with HM on the Ship's Hazardous Material List (SHML). As the Navy-wide Authorized Use List (AUL) comes into being, this effort will be expanded to include these items. The initial effort will also include any proposed new specifications.

7-1.2 Applicability. This Chapter does not apply to review of open purchase HM which are not the subject of a specification or a "controlling document." The procedures in other chapters of this manual are to be used for such materials. It also does not apply to special interest HM, for which ongoing substitution actions have been assigned by other Navy directives. These later include Ozone Depleting Chemicals (ODCs), Volatile Organic Chemicals (VOCs), and asbestos.

7-2 PRIORITIES

7-2.1 Initial Specification "Controlling Document" and Related NSN Targets. The initial actions called for in this Chapter are to be directed at the Navy Environmental Health Center's "Priority One List of Shipboard Hazardous Materials for Minimization/Replacement Action" and the US EPA Industrial Toxics Project (ITP) 17/33-50 Chemicals (see Tables 7-1 and 7-2). These initial priority HM are included in such Federal regulations and "lists" as the OSHA Permissible Exposure Limits (PEL), Clean Air Act Amendments of 1990's 190 extremely hazardous air pollutants, and EPA's list of hazardous materials subject to Emergency

Planning Community Right-to-Know (EPCRA, formerly SARA Title III). These "Target - Priority I" hazardous materials are components of a vast number of specifications and contracting document required items. Thus, the effort required calls for careful planning by Echelon 2 commands, and allocation of needed resources.

7-2.2 <u>Prioritization Procedures</u>. NAVSUPSYSCOM has been assigned action to review the SHML, establish a ranking scheme, and advise the cognizant SYSCOM or other organization having primary standardization responsibility for identified specifications and stock number materials. Figure 7-1 "Specification Identification and Prioritization" depicts the logic sequence for the current ranking scheme which is applicable to any similar initial screening to establish priorities for applying the substitution process described in this Manual. In brief, the process includes:

a. Identify the products containing one or more of the HM "target materials" cited in paragraph 7-2.1 above by reviewing the ingredients of the most current MSDS for that product.

b. Matching and sorting the MSDS with the NSN items in the SHML and the AUL when it comes into existence. The "matching" will result in a documentation of the target HM in each NSN and of each NSN with one or more target materials.

c. For each NSN, the number of annual maintenance actions is determined or estimated as is the pounds of that NSN procured.

d. A rank ordering is then accomplished, bringing together maintenance actions and procurement (e.g., lbs/100 maintenance actions or some similar ranking).

e. Grouping the NSNs with the relevant specifications and then identifying which SYSCOM or other preparing activity, as stated in the DOD Standardization Directory (SD-1).

f. Notifying the SYSCOM or other preparing activity for action to enter the NSNs into the Substitution process (Chapters 3 and 4) and to complete all necessary action, including any needed changes to the specifications. The implementing action must ensure that two key constraints are satisfied:

(1) Any substituted material must satisfy the test and evaluation requirements including: engineering suitability and that all required changes to documentation, and support needs are in place prior to availability of the new items.

(2) Pending complete action, supplies of existing materials must continue uninterrupted and phased out in sequence with availability of newly authorized materials. This is necessary so that no impact on mission availability occurs.

7-3 SUGGESTED PROCEDURES

Appendix E provides useful guidance and suggestions for consideration in the review process.

TABLE 7-1
NEHC PRIORITY ONE LIST SHIPBOARD
HAZARDOUS MATERIALS FOR MINIMIZATION/REPLACEMENT ACTION

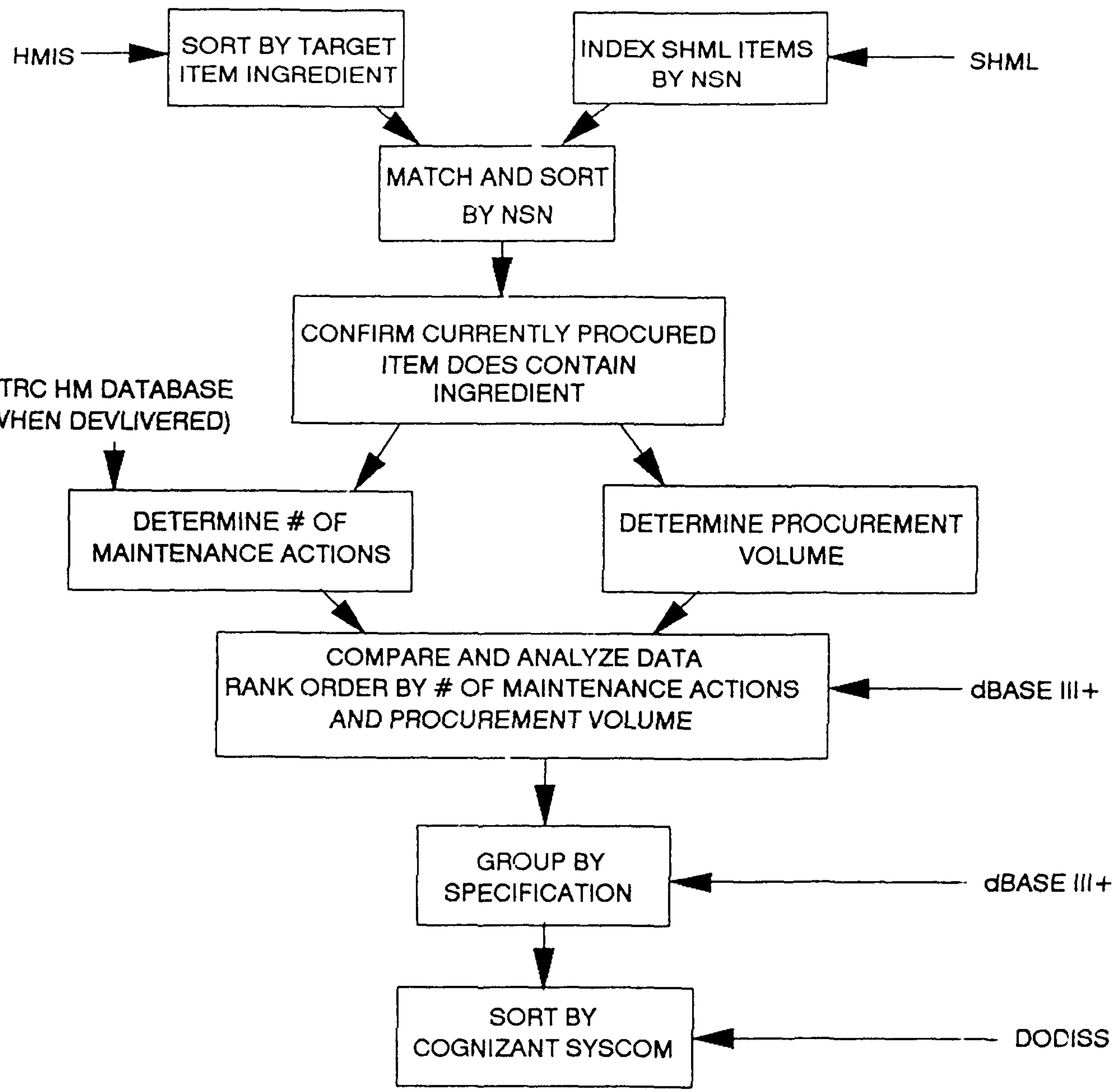
1. Asbestos
2. Benzene
3. Cadmium and Compounds (dusts, mists or fumes)
4. Chromium Compounds (dusts mists or fumes)
5. Glycol Ethers (EE/ME)
6. Halocarbon 113 (Freon 113)
7. Hydrazine (in all unsealed systems)
8. Lead and Lead-Based Paints, Alloys and Preservative Coatings
9. Mineral Oils (untreated and mildly treated)
10. Nickel and Nickel Compounds (dusts, mists or fumes)
11. Beryllium and Compounds
12. Coal Tars
13. 4,4 Methylene Dianiline
14. Methylene Chloride
15. Z-Nitro Propane
16. P-D-680
17. Polychlorinated Biphenyls
18. Tetrachloroethylene (Perchloroethylene)
19. Isocyanates
20. 1,1,1 - Trichloroethane (Methyl Chloroform)

TABLE 7-2
EPA INDUSTRIAL TOXICS PROJECT (33/50) CHEMICALS

1. Benzene
2. Cadmium and Cadmium Compounds
3. Carbon Tetrachloride
4. Chloroform (Trichloromethane)
5. Chromium and Chromium Compounds
6. Cyanide Compounds and Hydrogen Cyanide
7. Lead and Lead Compounds
8. Mercury and Mercury Compounds
9. Methylene Chloride (Dichloromethane)
10. Methyl Ethyl Ketone
11. Methyl Isobutyl Ketone
12. Nickel and Nickel Compounds
13. Tetrachloroethylene (Perchloroethylene)
14. Toluene
15. 1,1,1-Trichloroethane (Methyl Chloroform)
16. Trichloroethylene
17. Xylenes (All Xylenes)

FIGURE 7-1

SPECIFICATION IDENTIFICATION AND PRIORITIZATION



CHAPTER 8

DOCUMENTATION OF SUBSTITUTION ACTIONS

8-1 SCOPE

This Chapter provides guidance for preparing adequate documentation of analyses for substitution actions. Such documentation is required for several purposes. One is to provide higher authority with credible information for decisions to approve "high" or "serious" risk materials (as required by DoDI 5000.2, Part 6, Section I). Another is to bring together the results of the Chapter 3 substitution process (the substitution algorithm, life cycle cost/economic analyses, and engineering assessments) for approval of recommended substitutions by cognizant decision authorities. Such documentation is also needed for major actions to provide an audit trail in the event of future litigation.

8-2 DOCUMENTATION OUTLINE

8-2.1 The outline provided in Table 8-1 is suggested as a guide for documentation of substitution actions/recommendations. Attachments which support the findings and conclusions should be provided. These include the Algorithm "Worksheets," Economic Analyses, Reports of Engineering Analyses, etc. The aim is to provide a stand alone document that is complete in itself. The user of the document should not have to search for other documents or sources necessary to understand the findings and conclusions. The document should be tailored to the scope and extent of the HM substitution need it addresses.

8-3 COORDINATION AMONG CLAIMANTS

Substitution action by one major claimant may impact another. The process requires both early notification when action is initiated and in advance of final action. Documentation should clearly indicate concurrence or nonconcurrence by an affected claimant.

TABLE 8-1

HAZARDOUS MATERIAL SUBSTITUTION ACTION OUTLINE

1. Summary. This section briefly states the issue/need for the substitution action, the objective, alternatives considered, highlights of the analyses, conclusions and recommendations.

2. Background/Objective and or Requirements. Provide sufficient information so that a reviewer, unfamiliar with the issue, will understand the basic situation of concern.

3. Alternative Candidates Considered. Discuss how the candidate materials were identified and the rationale for their selection.

4. Application of the Substitution Process. Describe the "paths" of the Process Chart used, with explanation of the results (a figure may be useful, based on Figure 3-1). Indicate coordination with other Claimants.

5. Results of Analyses. Present in summary form the findings of the several analyses, the details being provided as attachments. A table showing results of each (i.e., The HSFs of the algorithm, life cycle costs, engineering suitability or not, etc.).

6. Other Considerations. Include here any other considerations which affect recommendations. These may be such elements as special mission requirements, special environmental restrictions, recognition of pending restrictive regulatory requirements. If there are impacts on the supply system or other impacts and costs (such as changes to MRC cards, etc.), provide details.

7. Conclusions/Recommendations. Furnish a succinct basis for selection of the preferred substitute. Include recommended needed following on actions (e.g., procurement action by NAVSUP, changes to maintenance controlling documents, environmental permits if required, etc.).

APPENDIX A

Step-By-Step Procedure for Comparing the Relative Hazards of Candidate Materials

SUBSTITUTION ALGORITHM WORKSHEET

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
1. A. Chemical			
B. On AUL?			
C. Operational Uses			
2. Health Hazard Severity Classification (HHSC)			
A. Exposure Restrictions			Points
B. Medical Effects			Points
C. HHSC - Points (2A+2B)			**Points**
- Category			Code
3. Mishap Probability Code (MPC)			
A. Length of Exposure			Points
B. Persons Exposed			Points
C. MPC - Points (3A+3B)			**Points**
- Category			
4. Risk Assessment Code (RAC)			
A. HHSC Category (2C)			
B. MPC Category (3C)			
C. RAC (Figure A-1)			**RAC**
5. Flammable/Combustible Liquids			
A. Flash Point (FP)			°F/°C
Boiling Point (BP)			°F/°C
B. Flammable/Combustible			**Points**
6. Personal Protective Equipment (PPE)			
A. PPE Requirements			
B. PPE			**Points**

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
7. Volatile Organic Compounds (VOC)			
A. Vapor Pressure (VP)			mm Hg
B. VP			**Points**
8. Environmental Impact Attributes			
A. New Hazard Potential			Points
B. EPA/State Bad Actor Lists			Points
C. Environmental Impact Statement (EIS)			Points
D. Federal/State Permits			Points
E. MILCON Project			Points
F. Environmental Assessment (EA)			Points
G. Reportable Quantities (RQ)			
1. RQ Code			Code
2. RQ			Points
H. Permissible Emissions			
1. Air Emissions			Tons/yr
2. Air Emissions			Points
I. Sum Points A through H			**Points**
9. Hazardous Material Selection Factor (HMSF)			
A. HMSF (2C+3C+5B+6B+7B+8I)			**Points**
10. Material Selection Recommendation			
A. RAC (4C)			**RAC**
B. HMSF (9A)			**Points**
C. Recommended Material RAC>2 & Lowest HMSF			

EXAMPLE SCENARIO 1
COMPARISON OF TWO INDUSTRIAL DEGREASERS
P-D-680, TY II vs. #134 HI-SOLV

Chemical A

MSDS for P-D-680, TY II*

FSN: 6850-00-110-4498
Manufacturer's Name: Magnaflux Surface Conditioners Inc.
Manufacturer's CAGE: 60672
Date MSDS Prepared:*** PRE-HCS
HMIS MSDS Serial Number: BCYYP

Chemical B

MSDS for #134 HI-SOLV*

FSN: 6850-01-244-3207
Manufacturer's Name: Bio-Tek Inc.
Manufacturer's CAGE: 59557
Date MSDS Prepared: 01 Feb 90
HMIS MSDS Serial Number: BGRGF

Work/Exposure Conditions**

Length of Exposure: 1-8 Hours/Week

Type of Work/Exposure: Irregular, Intermittent

Number of Persons Potentially Exposed: 38

* MSDS information taken from HMIS system.
** For the purpose of this scenario work/exposure conditions for Chemical A and Chemical B are considered similar.
*** Contact the manufacturer for the latest version of the MSDS for this product before proceeding with the evaluation.

SUBSTITUTION ALGORITHM WORKSHEET

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
1. A. Chemical	P-D-680, TY II	#134 HI-SOLV	
B. On AUL?	YES	NOT YET	
C. Operational Uses	DEGREASER	DEGREASER	
2. Health Hazard Severity Classification (HHSC)			
A. Exposure Restrictions	3	3	Points
B. Medical Effects	4	4	Points
C. HHSC - Points (2A+2B)	7	7	**Points**
- Category	III	III	Code
3. Mishap Probability Code (MPC)			
A. Length of Exposure	2	2	Points
B. Persons Exposed	7	7	Points
C. MPC - Points (3A+3B)	9	9	**Points**
- Category	C	C	
4. Risk Assessment Code (RAC)			
A. HHSC Category (2C)	III	III	
B. MPC Category (3C)	C	C	
C. RAC (Figure A-1)	4	4	**RAC**
5. Flammable/Combustible Liquids			
A. Flash Point (FP)	140/60	215/102	°F/°C
Boiling Point (BP)	355/179	450/232	°F/°C
B. Flammable/Combustible	4	2	**Points**
6. Personal Protective Equipment (PPE)			
A. PPE Requirements	COMBINATION GLASSES AND GLOVES	GLASSES	
B. PPE	4	1	**Points**

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
7. Volatile Organic Compounds (VOC)			
A. Vapor Pressure (VP)	10	0.33	mm Hg
B. VP	1	0	**Points**
8. Environmental Impact Attributes			
A. New Hazard Potential	10	0	Points
B. EPA/State Bad Actor Lists	0	0	Points
C. Environmental Impact Statement (EIS)	0	0	Points
D. Federal/State Permits	4	0	Points
E. MILCON Project	0	0	Points
F. Environmental Assessment (EA)	0	0	Points
G. Reportable Quantities (RQ)			
1. RQ Code	D	D	Code
2. RQ	2	2	Points
H. Permissible Emissions			
1. Air Emissions	40 (VOC)	NOT ON LIST	Tons/yr
2. Air Emissions	6	0	Points
I. Sum Points A through H	22	2	**Points**
9. Hazardous Material Selection Factor (HMSF)			
A. HMSF (2C+3C+5B+6B+7B+8I)	47	21	**Points**
10. Material Selection Recommendation			
A. RAC (4C)	4	4	**RAC**
B. HMSF (9A)	47	21	**Points**
C. Recommended Material RAC>2 & Lowest HMSF	#134 HI-SOLV		

EXAMPLE SCENARIO 2
COMPARISON OF TWO INDUSTRIAL CLEANERS
FREON 113 vs. #134 HI-SOLV

Chemical A

MSDS for FREON 113*

FSN: 6850-00-D00-1025
Manufacturer's Name: Hach Company
Manufacturer's CAGE: 91224
Date MSDS Prepared:*** 12 Mar 86
HMIS MSDS Serial Number: BBDSK

Chemical B

MSDS for #134 HI-SOLV*

FSN: 6850-01-244-3207
Manufacturer's Name: Bio-Tek Inc.
Manufacturer's CAGE: 59557
Date MSDS Prepared:*** 01 Feb 90
HMIS MSDS Serial Number: BGRGF

Work/Exposure Conditions**

Length of Exposure: 1-8 Hours/Week

Type of Work/Exposure: Irregular, Intermittent

Number of Persons Potentially Exposed: 38

* MSDS information taken from HMIS system.
** For the purpose of this scenario work/exposure conditions for Chemical A and Chemical B are considered similar.
*** Contact the manufacturer for the latest version of the MSDS for this product before proceeding with the evaluation.

SUBSTITUTION ALGORITHM WORKSHEET

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
1. A. Chemical	FREON 113	#134 HI-SOLV	
B. On AUL?	YES	NOT YET	
C. Operational Uses	CLEANER	CLEANER	
2. Health Hazard Severity Classification (HHSC)			
A. Exposure Restrictions	2	3	Points
B. Medical Effects	4	4	Points
C. HHSC - Points (2A+2B)	6	7	**Points**
- Category	III	III	Code
3. Mishap Probability Code (MPC)			
A. Length of Exposure	2	2	Points
B. Persons Exposed	7	7	Points
C. MPC - Points (3A+3B)	9	9	**Points**
- Category	C	C	
4. Risk Assessment Code (RAC)			
A. HHSC Category (2C)	III	III	
B. MPC Category (3C)	C	C	
C. RAC (Figure A-1)	4	4	**RAC**
5. Flammable/Combustible Liquids			
A. Flash Point (FP)	N/R	215/102	°F/°C
Boiling Point (BP)	118/48	450/232	°F/°C
B. Flammable/Combustible	0	2	**Points**
6. Personal Protective Equipment (PPE)			
A. PPE Requirements	COMBINATION SCBA, GOGGLES AND GLOVES	GLASSES	
B. PPE	9	1	**Points**

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
7. Volatile Organic Compounds (VOC)			
A. Vapor Pressure (VP)	334	0.33	mm Hg
B. VP	15	0	**Points**
8. Environmental Impact Attributes			
A. New Hazard Potential	0	0	Points
B. EPA/State Bad Actor Lists	8	0	Points
C. Environmental Impact Statement (EIS)	0	0	Points
D. Federal/State Permits	4	0	Points
E. MILCON Project	0	0	Points
F. Environmental Assessment (EA)	0	0	Points
G. Reportable Quantities (RQ)			
1. RQ Code	NOT ON LIST	D	Code
2. RQ	0	2	Points
H. Permissible Emissions			
1. Air Emissions	40 (VOC)	NOT ON LIST	Tons/yr
2. Air Emissions	6	0	Points
I. Sum Points A through H	18	2	**Points**
9. Hazardous Material Selection Factor (HMSF)			
A. HMSF (2C+3C+5B+6B+7B+8I)	57	21	**Points**
10. Material Selection Recommendation			
A. RAC (4C)	4	4	**RAC**
B. HMSF (9A)	57	21	**Points**
C. Recommended Material RAC>2 & Lowest HMSF	#134 HI-SOLV		

APPENDIX B

Substitution Worksheets and Examples

HAZARDOUS MATERIAL DESCRIPTOR INFORMATION

The purpose of this section is to provide the reader with background information on the general concepts, theories, and terms behind the "hazardous" classification. It has been divided into four parts: (1) basic terms used to describe the physical and chemical characteristics of materials; (2) fire and explosive descriptors; (3) concepts and terms used to describe the effects, both occupational and environmental, of hazardous materials; and (4) a discussion of hidden costs affecting hazardous materials use decisions.

1. Physical/Chemical Descriptors.

Every material in use today can be identified and classified by its physical/chemical properties. An understanding of the basic concepts behind each physical/chemical descriptor term is essential for the assessment of that material's hazard potential.

In making that assessment, it is necessary to understand the material's basic physical and chemical characteristics: "Is the material a gas or liquid at room temperature? Is the material heavier than air? Will the material mix with water?, etc." The answers to these types of questions can be found by looking at the following physical and chemical descriptors which can be found in the Material Safety Data Sheets (MSDSs).

CAS #	The Chemical Abstracts Service Registry Number (CAS #) is a number assigned to a material by the American Chemical Society's Chemical Abstracts Service. This number is used to identify materials without the confusion and error frequently found in chemical and trade names.
Chemical Formula	The chemical or molecular formula designates the elemental composition of the material and its basic structure.
Chemical Name	Many materials may have several names. The chemical name generally refers to the name derived from the chemical formula using the standard nomenclature used by the American Chemical Society's Chemical Abstracts Service. Other names for the material include trade names and the manufacturer's product name and number. Most MSDSs will provide both the manufacturer's product name and number, and the proper chemical name.
Molecular Weight	Molecular weight is the calculated weight of one molecule of the material. This weight is obtained by adding the individual weights of each atom in the chemical formula (carbon equals 12.01).

pH and Corrosivity

The pH of a material is its degree of acidity or alkalinity; a pH of <7 is acidic, 7 is neutral, and >7 is alkaline. Corrosivity is a characteristic of materials with pHs at either extreme of the scale.

Physical State

The physical state of a material is a solid, liquid, or gas (generally at room temperature and pressure 25 C and 760 mm hg). This information may or may not be provided directly by the MSDS since the nature of the product generally makes its physical state obvious.

Specific Gravity

Specific gravity refers to the weight of a solid or liquid substance, compared to the weight of an equal volume of water. Therefore, the specific gravity of water is one (1.0). A liquid or solid with a specific gravity of less than one will float on water; if its specific gravity is more than one, it will sink. Water solubility of a liquid has some bearing on whether it will sink or float.

Vapor Density

Vapor density is the relative density of a vapor or gas compared to air. Air is rated as one (1.0). A figure of less than one indicates a vapor or gas is lighter than air. A figure greater than one indicates a vapor or gas is heavier than air. Vapor density figures can be misleading because they are laboratory comparisons; during these laboratory measurements there is no air or vapor movement. In the field, we seldom find a pure gas or vapor; we deal with mixtures of vapor and air. These mixtures will not have the same vapor density as pure vapors or gases. Understandably, their weight will be closer to that of air. Further, vapors and gases become lighter when heated, and hot, upwelling air currents can lift heavy gases or vapors.

Vapor Pressure

Vapor pressure refers to the pressure built up in the limited space above the liquid by escaping molecules (vapors) of the material. At first, there are only a few vapor molecules in this space. Then, as more and more molecules turn into vapor, their random movement causes an increasing number to re-enter the liquid. Eventually, the number of arriving and departing molecules reaches an equilibrium. The pressure exerted by the escaping vapor against the sides of the container at this

point is called the vapor pressure of the liquid. Generally, it is measured in pounds per square inch Gage (psig). Gage pressure does not include the normal atmospheric pressure of 14.7 pounds. If atmospheric pressure has been included it is called absolute pressure and abbreviated psia. Vapor pressure varies with temperature. The higher the temperature, the greater the number of molecules that move fast enough to escape, and the higher the vapor pressure.

Water Solubility — Water solubility is the ability of a material to form a homogeneous solution with water. For example, oil is not water soluble; whereas, salt is.

2. <u>Fire and Explosion Data Descriptors</u>.

The following terms are used to describe a material's fire and explosion characteristics:

Auto-ignition Temperature — The minimum temperature at which a flammable gas or vapor/air mixture will ignite from its own heat or a contacted heated surface without the use of a spark or flame.

Fire Point — The lowest temperature at which the vapor/air mixture will continue to burn after it is ignited, generally a few degrees above the flash point.

Flammable Limits — In the case of gases or vapors which form flammable mixtures with air or oxygen, there is a minimum concentration of vapor in air or oxygen below which propagation of flame does not occur. These boundary-line mixtures of vapor or gas with air, which if ignited will just propagate flame, are known as the "lower and upper flammable or explosive limits" and are usually expressed in terms of percentage by volume of gas or vapor in air.

Flammable Range — The range of flammable vapor or gas/air mixture between the upper and lower flammable limits is known as the "flammable range," also often referred to as the "explosive range."

Flash Point — The flash point is the minimum temperature at which a material (liquid) gives off sufficient vapor to form an ignitable mixture with the air near the surface of the liquid. Some evaporation takes place below the flash point but not in sufficient quantities to form an ignitable mixture.

Ignition Temperature	The ignition temperature of a substance, whether a solid, liquid, or a gas, is the minimum temperature required to initiate or cause self-sustained combustion independently of the heating or heated element. Some of the variables known to affect ignition temperatures are composition of the vapor or gas/air mixture, shape and size of the space where ignition occurs, rate and duration of heating, kind and temperature of the ignition source, catalytic or other effect of materials that may be present, and oxygen concentration.
Propagation of Flame	"Propagation of flame" is the spread of flame from the source of ignition through a flammable mixture. The use of the term flame propagation distinguishes between combustion which takes place only at the source of ignition and that which travels (propagates) through the mixture.
Rate of Diffusion	Indicates the tendency of one gas or vapor to disperse into, or mix with, another gas or vapor, including air.

3. <u>Occupational and Environmental Effects Descriptors</u>.

In addition to a material's hazard potential determined by its physical characteristics, a material may have other adverse effects. These adverse effects may present a hazard both to the user (occupational hazard) and/or to the environment (environmental hazard). The following concepts are used in defining a material's occupational and environmental characteristics:

a. Occupational Hazards. The occupational effects of a material which are not directly related to its physical hazards (i.e., flammability or chemical burns) are generally described as the material's toxicity. A toxic effect can be defined as any noxious effect on the body, reversible or irreversible; any chemically induced tumor, benign or malignant; and any mutagenic or teratogenic effect or death resulting from contact with a substance via the respiratory tract, skin, eye, mouth, or any other route. Toxic effects may also arise as side effects in response to exposure to some materials.

> "It is important to realize that toxicity is a property of matter. It is a physiological property which defines the capacity of a chemical to do harm or produce injury to a living organism by other than mechanical means. Toxicity entails a definite dimension, that of quantity or amount. On this basis, then, the toxicity of any chemical is dependent upon the degree of exposure."

The following terms are frequently used when discussing the occupational effects of a material:

Acute Exposure	Entails a short duration. Means exposure to chemicals absorbed by inhalation, dermally, or by ingestion with the duration of total exposure measured in seconds, minutes, or hours. As applied to ingestion, it means a single dose.
Asphyxiants	Asphyxiants prevent oxygen from reaching the body cells. Either by displacing the "normal" oxygen-containing air (simple asphyxiants), or by interfering with the lung-blood-cell transfer of oxygen.
Carcinogens	Carcinogens are substances which are known to cause, or are suspected of causing, cancer. Cancer can have a long latency period, with a possible lapse of 20 or 30 years between exposure and appearance of the cancerous tumors.
Chronic Exposure	Means exposures of long duration and as applied to dermal and inhalation covers prolonged or repeated exposures with durations of days, months, or years. With ingestion, it means repeated doses of the chemical for days, months, or years.
Hazard	Hazard is defined as the likelihood that a chemical will cause injury under circumstances of ordinary use.
Hepatotoxic Agents	These materials have a toxic effect on the liver.
Irritants	Irritants inflame the surfaces of the parts of the body by their corrosive action. The area most often subjected to an exposure to an irritant is the skin. The moist body surfaces, especially the lungs, are very sensitive to irritant exposure. Even a weak irritant to the upper respiratory tract will be easily detectable by the victim. Note that deep exposure to irritants (i.e., exposure in the lower respiratory tract) may go unnoticed.
Nephrotoxic Agents	These materials have a toxic effect on the kidneys.
Neurotoxic Agents	These materials have a toxic effect on the nervous system.

[1] Fundamentals of Industrial Hygiene, 2nd Edition, 1985, National Safety Council, Julian B. Olishifski, P.E., C.S.P.

Subchronic Exposure	Means intermediate exposures between acute and chronic and may be for up to 90 days.
Systemic Poisons	Systemic poisons attack specific organs or systems of organs, sometimes with toxic mechanisms that are not understood.
Teratogens and Mutagens	Teratogens and mutagens are two types of reproductive disorders often associated with an occupational hazard. Teratogens affect the fetus, so their toxic effect is indirect. Women should be careful about exposures to such substances during pregnancy, especially in the first trimester. Mutagens attack the chromosomes of the species instead of the individual. Teratogens are damaging between conception and birth; whereas, mutagens are harmful before conception.
Toxicity	Toxicity is defined as the ability of a chemical to cause injury once it reaches a susceptible site in or on the body.

b. Environmental Hazards. Every material used by man has some environmental cost or effect associated with it. The difference between an environmental effect and an environmental hazard is a matter of degree. Determining the "degree" of an environmental hazard is a very subjective process. It must evaluate factors such as: the toxicity of the material, the quantity of the material used, how the material is used, and how can/will it enter the environment. The extent and nature of these effects will influence a decision in two ways to use, or not to use, a material. First, the material's environmental hazards may by themselves be the determining factor in classifying a material as hazardous. Secondly, when selecting a material from a group of hazardous or non-hazardous materials, the environmental hazards associated with each material must be considered (given two HMs with all else being equal, the material with the least environmental hazard potential would be selected).

The following concepts are frequently used in discussing a material's environmental hazards:

Bioaccumlation and Bioconcentration	Bioaccumulation refers to the tendency of a material to accumulate in specific tissues or organs of an exposed organism. Bioconcentration refers to the food chain process where the dose level increases in organisms higher up the food chain. (If a rat population has a 10mg level of DDT exposure, a predator eating two rats could have an exposure greater than 10mg.)
Biological Oxygen Demand (BOD)	BOD refers to the measure of organic nutrient pollution in a body of water. The more organic nutrient pollution in the

water, the greater the demand for oxygen by the organisms breaking down the nutrients.

Ecosystem and Ecology	An Ecosystem is defined as all the living organisms and the non-living matter with which they interact (eat, breath, walk on, etc.) in a given area or environment, e.g., "this isolated island" or "all coral reefs." Ecology is the study of ecosystems.
Primary Air Pollutants	These are airborne contaminants which have not undergone any chemical reaction since being introduced into the environment.
Secondary Air Pollutants	These are airborne contaminants which have undergone one or more chemical reactions (with material naturally in the air or pollutants) since being introduced into the environment.

APPENDIX C

Hazardous Material Descriptor Information

SUBSTITUTION ALGORITHM

STEP 1. NEEDED INFORMATION FOR ANALYSES

A. GUIDANCE MANUAL FOR SELECTION/SUBSTITUTION OF LESS HAZARDOUS MATERIALS
B. OBTAIN LATEST MSDS FOR CANDIDATE MATERIAL
C. WORK HOURS DATA
D. NUMBER OF PERSONNEL POTENTIALLY EXPOSED
E. NIOSH POCKET GUIDE TO CHEMICAL HAZARDS
F. EPA "TITLE III, LIST OF LISTS" OR 40 CFR 302.4
G. AIR TOXICS LIST OF HAZARDOUS AIR POLLUTANTS
H. STATE ENVIRONMENTAL REQUIREMENTS (VOC LISTS, ETC.)
I. PEL LIST FROM OSHA/29 CFR 1910.1000
J. TLV LIST FROM ACGIH
K. "HAZARDOUS MATERIALS USER'S GUIDE"/OPNAV P-45-110-91

STEP 2. HEALTH HAZARD SEVERITY CLASSIFICATION (HHSC)

A. EXPOSURE RESTRICTIONS

- Use the lowest listed PEL* or TLV** value for the material being evaluated.

- For materials with a time weighted average (TWA) given only in parts per million (ppm) or in both ppm and milligrams per cubic meter (mg/m^3), only use the value given in parts per million with table 2A.1 to determine the points awarded for exposure restrictions.

- For materials with a TWA given only in mg/m^3, only use the value given in mg/m^3 with Table 2A.2 to determine the points awarded for exposure restrictions.

- When evaluating mixtures select the component with the lowest listed PEL or TLV value. Use this value to determine the points awarded for exposure restrictions.

- Note for mixture evaluation only: If the lowest PEL or TLV is given in mg/m^3 , evaluate the mixture twice, once using the (lowest) listed mg/m^3 value and once using the lowest listed ppm value. Award this mixture the higher point value for exposure restrictions.

* Permissible Exposure Limit -- 29 CFR 1910.1000
** Threshold Limit Value -- American Conference of Governmental Industrial Hygienists (ACGIH)

TABLE 2A.1

Parts Per Million (PPM)	Points
0 to 100	8
101 to 175	7
176 to 250	6
251 to 335	5
336 to 417	4
418 to 500	3
501 to 1000	2
> 1000	1

TABLE 2A.2

Milligrams per Cubic Meter (mg/m^3)	Points
0.00 to 0.5	8
0.51 to 2.0	7
2.01 to 3.5	6
3.51 to 5.0	5
5.01 to 7.0	4
7.01 to 8.0	3
8.01 to 10.0	2
> 10.0	1

B. MEDICAL EFFECTS

Condition*	Points
1. No medical effect, such as nuisance noise and nuisance odor	0
2. Temporary reversible illness requiring supportive treatment, such as eye irritation and sore throat	2
3. Temporary reversible illness with a variable but limited period of disability, such as metal fume fever	4
4. Permanent, non-severe illness or loss of capacity, such as permanent eye damage	6
5. Permanent, severe, disabling, irreversible illness or death, such as asbestosis and lung cancer	8

* Consult the NIOSH Pocket Guide to Chemical Hazards to determine the medical effects of the MSDS's ingredient list. The MSDS health hazard data may lead to inaccurate results.

C. DETERMINE HHSC POINTS AND CATEGORY

Total A & B Points	Resulting Code
13-16	I
09-12	II
05-08	III
00-04	IV

STEP 3. ESTABLISH MISHAP PROBABILITY CODE (MPC)

A. LENGTH OF EXPOSURE TIME

Type of Work/Exposure	Points Based On Length of Exposure (hours/week)		
	1-8 Hours	>8 Hours (not continuous)	Continuous
Irregular, Intermittent	2	5	NA
Regular, Periodic	3	6	8

B. NUMBER OF PERSONS POTENTIALLY EXPOSED

Persons	Points
1-2	1
3-5	2
6-7	3
8-9	4
10-22	5
23-35	6
36-49	7
>49	8

C. DETERMINE MPC POINTS AND CATEGORY

(Sum of Step A & B Points)	Category
14-16	A
10-13	B
6-9	C
0-5	D

STEP 4. RAC DEVELOPMENT

A. HHSC CATEGORY FROM STEP 2C

B. MPC CATEGORY FROM STEP 3C

C. DETERMINE RAC NUMBER FROM FIGURE 1

RAC 1 = HIGH RISK
RAC 2 = SERIOUS RISK

STEP 5. FLAMMABLE/COMBUSTIBLE LIQUIDS EVALUATION

A. DETERMINE FLASH POINT AND BOILING POINT TEMPERATURES IN DEGREES FAHRENHEIT

FLAMMABLE LIQUIDS °F (°C) ≤141°F (61°C)

Flash Point (FP)	Boiling Point(BP)	Points
Below 73 (23°C)	Below 100 (38°C)	10
Below 73 (23°C)	At/above 100 (38°C)	9
At/above 73 (23°C) and Below 100 (38°C)		8

COMBUSTIBLE LIQUIDS °F (°C) >141°F (61°C) ≤200°F (93°C)

Flash Point (FP) At or Above	Flash Point (FP) and Below	Points
142 (61°C)	170 (77°C)	6
170 (77°C)	200 (93°C)	4
200 (93°C)	---	2

B. FLAMMABLE/COMBUSTIBLE LIQUIDS POINTS

STEP 6. PERSONAL PROTECTIVE EQUIPMENT (PPE) EVALUATION

A. DETERMINE PPE REQUIREMENTS

Sources:

1. The most current "NIOSH Pocket Guide to Chemical Hazards," DDHS (NIOSH) Publication No. 90-117.
2. MSDS
3. "Hazardous Material User's Guide," OPNAV P-45-110-91
4. Medical and/or Safety professional assistance

B. DETERMINE PPE POINTS

PPE REQUIREMENTS	POINTS
1. Either faceshield, gloves, apron, or bootees (one point skin protection)	1
2. One or more combination of faceshield, gloves, apron, or bootees (multiple point skin protection)	2
3. Goggles (eye protection)	3
4. Combination of goggles and gloves, apron, or bootees (eye and skin protection)	4

DETERMINE PPE POINTS (Continued)

PPE REQUIREMENTS*	POINTS
5. Cartridge/canister respirator one-half facepiece for gas, vapor, and/or particulate contamination (respiratory protection)	5
6. Cartridge/canister respirator full facepiece for gas, vapor, and/or particulate contamination (respiratory and eye protection)	6
7. Combination of cartridge/canister respirator full facepiece for gas, vapor, and/or particulate contamination and gloves, apron, and/or bootees (respiratory, eye, and skin protection)	7
8. Supplied air respirator or self contained breathing apparatus (respiratory and eye protection)	8
9. Combination of supplied air respirator or self contained breathing apparatus and gloves, apron, and/or bootees (respiratory, eye, and skin protection)	9
10. Supplied air respirator or self contained breathing apparatus and full impervious suit (complete protection)	10

* Do not use the MSDSs to determine PPE requirements

STEP 7. VOLATILE ORGANIC COMPOUND (VOC) EVALUATION

A. DETERMINE CHEMICAL VAPOR PRESSURE (VP) AT 70 DEGREES F

B. DETERMINE VP POINTS

VAPOR PRESSURE (mm Hg @ 70° F)	POINTS
201 and Higher	15
101 to 200	12
91 to 100	10
81 to 90	9
71 to 80	8
61 to 70	7
51 to 60	6
41 to 50	5
31 to 40	4
21 to 30	3
11 to 20	2
1 to 10	1
BELOW 1	0

STEP 8. ENVIRONMENTAL IMPACT EVALUATION

Environmental Attributes	Points
(Note: Consider each attribute a separate item of evaluation. A total of 34 points can be attained from A through F.)	
A. New Hazard Potential -- Material results in a changed hazard potential (fire hazard, change in media (e.g., air pollutant to solid waste, etc.)). Assess points against candidate material exhibiting worst hazard.	10
B. EPA/State Bad Actor Lists -- Material is on EPA Priority Pollutant list, Air Toxics List, EPA or State list of volatile organic compounds (VOC), ozone depleters, etc.	8
C. Environmental Impact Statement (EIS) -- Projected use requires EIS	6
D. FEDERAL/STATE Permits -- Projected use involves air or water quality permit, or State Implementation Plan requirements, etc.	4
E. MILCON PROJECT -- Projected use requires hazard control facilities and equipment, with military construction (MILCON) in excess of $200,000	4
F. Environmental Assessment (EA) -- Projected use requires an EA	2

G. REPORTABLE QUANTITIES POINTS -- Evaluate materials listed on EPA's "List of Hazardous Substances and Reportable Quantities (RQ)" (40 CFR 302.4) (See Figure 2 for example) or EPA's "TITLE III, List of Lists" (RQ columns)

1. DETERMINE REPORTABLE QUANTITIES CODE

2. DETERMINE REPORTABLE QUANTITIES POINTS

Table 302.4 Final RQ Category		Points
X	(1# or less)	10
A	(1# to 10#)	8
B	(10# to 100#)	6
C	(100# to 1000#)	4
D	(1000 to 5000#)	2
Not on list		0

H. CLEAN AIR ACT Permissible Emission -- Evaluate EPA Clean Air Act Permissible Emission Rates for Material (40 CFR 52.21(b)(23)) (See Figure 3 for example)

1. DETERMINE TONS PER YEAR OF AIR EMISSIONS

2. DETERMINE AIR EMISSIONS POINTS

Allowable Tons Per Year	Points
7 or less	10
8 - 25	8
26 - 40	6
41 - 100	4
> 100	2
Not on list	0

I. SUM TOTAL A THROUGH H POINTS

STEP 9. DEVELOP HAZARDOUS MATERIAL SELECTION FACTOR (HMSF)

A. ADD TOTAL POINTS FROM STEPS 2C, 3C, 5B, 6C, 7B, AND 8I. THIS IS THE NUMERICAL HMSF FOR THIS CANDIDATE MATERIAL

STEP 10. MATERIAL SELECTION RECOMMENDATION

A. LIST RAC FOR CANDIDATE MATERIAL (FROM STEP 4C)

B. LIST HMSF FOR CANDIDATE MATERIAL (FROM STEP 9A)

C. FROM THE CANDIDATES, RECOMMEND THE HAZARDOUS MATERIAL WITH THE LOWEST HMSF AND RAC NUMBER OF 2 OR HIGHER. (NOTE: THE HIGHER THE HMSF, THE HIGHER THE ENVIRONMENTAL, HEALTH, AND SAFETY RISK.)

Determine RAC Using Matrix, enter at HHSC and Correlate with MPC

Mishap Probability (MPC)

		A	B	C	D
Hazard Severity (HHSC)	I	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	3	4	5	5

Note: Interpretation of HM Selection Risk Assessment Code

RAC 1 = High Risk (Imminent danger to life or property; possible civil or criminal action)

RAC 2 = Serious Risk (May result in severe injury or illness on or off site, potential for major damage to environment and resulting notice of violation)

RAC 3 = Moderate Risk (May cause few illnesses or injuries or significant property damage or environment impact on or off site)

RAC 4 = Low Risk (Can result in only minor impact on or off site or only violation of a standard without damage)

RAC 5 = Negligible (Insignificant impacts)

Figure 1

TABLE 302.4 - LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES

Hazardous Substance	CASRN	Regulatory Synonyms	Statutory			Final RQ	
			RQ	Code	RCRA Waste Number	Category	Pounds (Kg)
Acenaphthene.......	83329	....	1*	2	......	B	100(45.4)
Acenaphthylene.....	208968	....	1*	2	......	D	5000 (2270)
Acetaldehyde.......	75070	Ethanal............	1000	1,4	U001	C	1000 (454)
Acetaldehyde, chloro...	107200	Chloroacetaldehyde..	1*	4	P023	C	1000 (454)
Acetaldehyde, trichloro	75876	Chloral.............	1*	4	U034	X	1#(0.454)
Acetamide, N-(aminothioxomethyl)-.	591082	1-Acetyl-2-thiourea..	1*	4	P002	C	1000 (454)
Acetamide, N-(4-ethoxyphenyl)-.	62442	Phenacetin...........	1*	4	U187	X	1#(0.454)
Acetamide, N-9H-fluoren-2-yl-.	53963	2-Acetylaminofluorene	1*	4	U005	X	1#(0.454)
Acetamide, 2-fluoro-...	640197	Fluoroacetamide......	1*	4	P057	B	100 (45.4)
Acetic acid...........	64197	....	1000	1	......	D	5000 (2270)

Figure 2

"SIGNIFICANT" POLLUTANT EMISSION RATES

Pollutant	Emission Rate (tons/year)
Carbon monoxide (CO)	100
Nitrogen oxides (NO_x)	40
Sulfur dioxide (SO_2)	40
Particulate matter	25
Ozone	40*
Lead	0.6
Asbestos	0.007
Beryllium	0.0004
Mercury	0.1
Vinyl chloride	1
Fluorides	3
Sulfuric acid mist	7
Hydrogen sulfide (H_2S)	10
Total reduced sulfur (including H_2S)	10
Reduced sulfur compounds (including H_2S)	10
Any other pollutant	Any amount

* 40 tons per year of volatile organic compounds.

Source: 40 CFR 52.21(b)(23)(i-ii)

Figure 3

APPENDIX D

Life Cycle Cost Model
Developed by Naval Research Center
for HM Studies

(To Be Done At A Later Date)

APPENDIX E

Suggested Procedures for HM Specification Review Process

Suggested Procedures for HM Specification Review Process

1. Criteria. Once products containing one o more of the chemicals from the NEHC Priority I list or the EPA ITP list are identified from the SHML, a list of the "controlling documents" can be developed for review/revision. During the review and revision process, health, safety and environmental protection criteria which are consistent, comprehensive and defensible, will be used in the analysis to reduce or remove the listed HM, as well as reducing or removing the chemicals which may be contained in the product. This will ensure that impacts from all HM are addressed at the same time. Additionally, it will ensure: (a) consistent results among all commands involved in the review and revision process; and (b) that criticisms and protests from manufacturers and vendors will be minimized both during the revision process and later during procurement. The Navy faces a broad spectrum of environmental, safety and health hazards and risks. The traditional types of hazards and risks to personnel, safety and health have been identified but the definitions must be expanded to include the impact of the numerous environmental regulations promulgated in the past twenty years. All the pertinent associated risks and impacts must be considered in developing the revision criteria. One method of considering these risks is the use of the Substitution Risk Assessment Algorithm (Appendix 1). The algorithm uses numerical "points" which are assigned to the traditional types of hazards and risks to personnel, safety, health and environment, ultimately providing a numerical score and a Risk Assessment Code. These, taken together, become a material's Hazardous Material Selection Factor (HMSF) and allows comparison of one HM to another based on a known set of criteria.

2. Identifying Controlling documents for Review/Revision.

(1) NAVSUP. NAVSUP is tasked with analyzing the SHML to provide the following information to the cognizant systems command (SYSCOM):

i) Identity of the Specification. Identify the specification that corresponds to each SHML item containing one or more of the chemicals listed above.

ii) Groups National Stock Numbers (NSNs). Group all related NSNs under their parent specification.

iii) Identity of the Preparing Activity. Identify the activity, as outlined in DOD Standardization Directory, SD-1, that will be responsible for reviewing/revising each specification.

iv) Provide List. Provide the HMC&M program manager at each preparing activity a list of the controlling documents and their related NSNs for review/revision.

(2) Preparing Activities, Custodians, Review and User Activities. Each HMC&M program manager will distribute the controlling documents to the appropriate codes with their commands for review and revision.

3. Constraints. In keeping with a systems approach to specification review, certain constraints must be adhered to:

(1) Material Availability. The specification review/revision process must ensure that specified material is available at all times to construct, operate, maintain and repair ships. Supplies in the system must continue uninterrupted, so maintaining sources of supply must always be a consideration in the revision process.

(2) Performance Integrity. Specification changes must not be made without consulting the cognizant engineers(s). Products must continue to meet the performance requirements. Consequently, the engineering aspects of any change must always be considered and performance should not be compromised.

4. Procedures for Review/Revision.

(1) Information. The first step in a technical review directed at reducing or eliminating HM is to identify each product manufactured to a particular specification and the HM content of each product.

i) Controlling documents with Qualified Products List (QPL). The QPL is a list of all manufacturers that have previously undergone testing and evaluation of their product and have been found to comply with the specification. If a QPL exists for a specification, qualified vendors and manufacturers and their products can be identified for analysis. Often more than one vendor is listed for the same manufacturer's product so the QPL must be scrutinized to determine exactly how many different products are actually represented by the QPL.

ii) Controlling documents without QPLs. A majority of the controlling documents do not have QPLs. In these cases, information about manufacturers and vendors must be gleaned from the procurement histories for the items purchased under each specification.

iii) Performance/Formulation Controlling documents. The process of determining a product's composition varies depending upon which type of specification it is manufactured under. In the case of formulation controlling documents, the composition is part of the specification. The compositions of products under a formulation specification will be nearly identical, usually with the constituent content specified within a narrow range or as "no

more than" or "no less than." Performance controlling documents pose a more complex problem. Rather than specify a composition, performance criteria is specified allowing the manufacturer to formulate the product as he wishes as long as the product meets those criteria. Heretofore, this allowed different products purchased by the government under one specification and stocked under one NSN to vary widely in composition and degree of hazard.

iv) Material Safety Data Sheets (MSDSs). The next step is a search of the Hazardous Material Information System (HMIS) for MSDSs for each product. If the MSDSs are not in HMIS or if they are incomplete or out-of-date, then up-to-date MSDSs must be requested directly from the manufacturer. Although Federal Standard (FED-STD) 313C requires manufacturers to put percentage composition of hazardous materials on their MSDSs, such information is frequently lacking, because the current OSHA Form 174 allows percentage of ingredients to be optional. Further, a manufacturer may withhold such information on the basis it is a "trade secret."

(2) Analysis and Revision. The process of revision controlling documents to reduce or eliminate hazardous material is complex. The danger is in trying to apply a simple solution to this complex problem. The analysis of the products under a specification consists of evaluating each hazardous ingredient of each product using the types of criteria discussed in Section 3.c. Primary emphasis will be on the chemicals listed in Table I and Table II with secondary emphasis on all other hazardous substances that might be part of the same product. Each product, as a whole, must also be evaluated using the same criteria since the combined ingredients may exhibit different characteristics each component separately. Such an evaluation may be accomplished using the Substitution Risk Assessment Algorithm as one part of the analysis. For the consideration of HM entering the cycle ar an early stage of development (Phase I, Milestone I or before) the Life Cycle Cost Model is a tool for the engineer or logistician to compare the cost of using a specific HM across the entire life cycle of the systems or equipment and competing materials against each other. As each product and its ingredients are analyzed, opportunities for changes to reduce or eliminate the hazards represented are identified in safety, health and environment. It is unlikely that all of the HM can be eliminated and that improvements can be made in all three criteria categories for every HM. Each product and its ingredients will require individual analysis and several options are available to accomplish this process. It is desirable that the manufacturers be apprised of the Navy intention to reduce or eliminate Hm in controlling documents and that their counsel be sought in the analytical process. Likewise, the In-Service Engineering Agent (ISEA) must be consulted in those cases where performance requirements may be affected since the various applications of the product within the Navy (and possibly other Services) determine what changes can be made to a product and

have it fulfill its intended purpose. Some for the options and their relative complexity are discussed below.

i) Eliminating Most Hazardous Products. This is one of simplest options and requires minimal engineering effort to accomplish. Figure 1 is an example of an actual SHML item with a NSN and MILSPEC. Four different products are listed on the QPL. An analysis of the ingredients identified in the product MSDSs revealed a wide discrepancy in the amount of lead contained in each of the four products. The top two products each contain less than 1% lead while the other two contain more than 20%. In this example, the specification simply could be revised to limit the lead content to no more than 1%. This type of change would not affect the performance requirements since the lower lead products have already been tested and determined to meet the specification. Because there are at least two products available, competition is maintained and supply is not interrupted.

ii) Reducing Hazardous Characteristics. Another example, similar to the above, would be a specification with four products on a QPL, two with flash points over 200 F, the remaining available products are safer to use and simpler to store, especially aboard ship. As above, no changes have been made to the performance requirements and supply and competition have been maintained.

iii) Reducing or Eliminating Hazardous Ingredient(s). For many SHML items, the available products associated with a specific NSN and specification contain a variety of hazardous ingredients, all in roughly the same proportions to each other. Before reducing or eliminating any of these ingredients, engineering consultation is necessary to determine the purpose and necessity of the ingredient in the product and the minimum quantity of the ingredient to meet performance requirements. Manufacturer input at this stage is desirable.

iv) System Reengineering (Reverse Engineering). The most complicated and costly situation is when an entire system may need to be redesigned to eliminate HM. Developing new refrigeration technologies to eliminate the use of freon is one example. This process may involve extensive research and development and may be very costly if the system applications are widespread. This type of effort may also require system change-outs in addition to the HM elimination. Fortunately, the majority of items in the SHML are consumables and their reduction/elimination fall into the other three categories above.

(3) Change Considerations. Opportunities to improve a specification with regard to HM are fairly constrained. However, consideration should be given to the following ideas, when possible:

i) Products with relatively low flash points present a fire hazard onboard ship and every effort should be made to raise the flash points to lessen that hazard.

ii) In addition to eliminating or reducing HM present in a product, the specification must be structured in such a way to preclude new HM from being introduced in the future. In some cases this could be accomplished by adding blanket restrictions to the Federal Acquisition Regulations/Defense Federal Acquisition Regulations (FAR/DFAR) in lieu of making individual specification changes.

iii) The process of revising a specification could eliminate most or all of the vendors that are able to supply the government under a particular specification. To avoid that, and to ensure an uninterrupted supply of material to the fleet, the process of specification "tightening" may have to be implemented in stages to allow manufacturers time to reformulate or develop new products. As an example, a particular HM could be reduced incrementally every two years until eliminated or as much as possible to maintain performance. Supply must be maintained and at the same time manufacturers will need time and incentive to change their products.

iv) Publicity through official channels such as the Commerce Business Daily (CBD) and unofficial channels such as the media should be used to the maximum extent possible to get the message to current suppliers and to encourage manufacturers with safer and healthier products to do business with the government.

5. Transition to New Products. As new products are introduced t the supply system because of revised controlling documents, it is important that the transition process be carefully planned. Abrupt bans on old materials create confusion in the fleet and may turn current HM inventories into instant HW. A transition plan must be part of the specification revision package and must be coordinated with NAVSUP who will provide technical assistance on supply issues.

6. Integration Into Existing Programs. The initial thrust of this effort will be an intensive effort to review existing controlling documents containing chemicals listed in Table I and Table II. The effort will then transition into an integral part of each Preparing Activity's formal Specification Improvement Program. As controlling documents are due for periodic review, the health, safety and environmental analysis will then become an additional item of consideration in the overall review/revision process.